EC'S INTERNAL MARKET AND DENMARK: AN APPLIED GENERAL EQUILIBRIUM ANALYSIS

By

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by

Nathan Wajsman

To my parents

Lidia and Michael Wajsman

Brøndby Strand, Denmark

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In this study, the implications for the Danish economy of European Commission tax harmonization proposals and of possible reform of the Common Agricultural Policy are analyzed using a Shoven-Whalley computable general equilibrium model. The policies simulated include reductions in indirect taxes and abolition of agricultural subsidies and price supports. The implications of different parameter specifications and closure rules are explored.

The study concludes that tax harmonization would impose considerable dislocations on the Danish economy and require compensating cuts in government spending to prevent unacceptable deterioration of the current account and government budget deficits. Abolition of the Common Agricultural Policy would on balance reduce welfare by about 3-4%.

CHAPTER 1
INTRODUCTION

Overview of European Integration

The European Community (EC) was formed in 1957 by Germany, Italy, France, Holland, Belgium and Luxembourg. The basic goal of the Community, explicitly mentioned in the founding document, the Treaty of Rome, was to create a united Europe through a widening and deepening of cooperation among the countries involved. Even though the initial focus was on removal of trade barriers, it was understood from the beginning that the role of the Community would later be broadened to include new policy areas.

At the core of the EC is the principle of free movement of goods, services, labor and capital. The first step was formation of a customs union, i.e. abolition of all tariffs and quotas among the six countries and adoption of a common external tariff. The process was to be gradual, scheduled for completion in 1970. The removal of internal tariffs and quotas was by and large accomplished in 1968.

During the 1970s many EC initiatives aimed at expanding the role of Community institutions to new areas failed. For example, plans for a monetary union, which had been formulated in 1969, stalled following the disruptions in the international monetary system in the early 1970s. The European Monetary System (EMS) was eventually formed in 1979 but several EC members, including Britain, did not participate in it[1]. Likewise, attempts at formulating a common energy policy after the energy crisis of 1973-74 were unsuccessful. Although some new policies were developed (e.g. the fisheries policy) and the Community was enlarged with Britain, Ireland, and Denmark in 1973, Greece in 1981, and Spain and Portugal in 1986, the 1970s and the early 1980s were a period of stagnation in the EC. The macroeconomic problems, including the recessions of 1974-75 and 1980-82, only made matters worse. Rather than working towards increased cooperation, the EC member countries pursued nationalist objectives through unilateral non-tariff barriers to trade and state subsidies to industries such as steel, shipbuilding, and automobiles. In addition, there was continuing wrangling in Brussels over the EC budget issue, with some countries, especially Britain, arguing that their net contribution to the budget was unjustly high.

This pattern of stagnation was broken with the publication of the EC Commission's White Paper, "Completing the Internal Market" (Commission, 1985), and the subsequent passage by the Council of Ministers of the Single European Act (SEA) and its ratification by the member countries in 1986.

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[1] Britain joined the EMS in December 1990.

The SEA is a bold attempt to move toward a united Europe in a pragmatic way. The Act consists of about 300 directives addressing specific areas where remaining impediments to the free movement of goods, services and factors of production are to be removed by 1 January 1993. In addition, the Act allows decisions on these directives to be made with a qualified majority in the Council of Ministers rather than unanimity. This is a crucial change in the way EC is governed. It means that a decision of the Council can now only be blocked by a coalition of at least three countries (and then only if such a coalition includes one of the four big countries - Britain, Germany, France, or Italy). During the debate in some of the smaller EC member countries this loss of veto power was an extremely controversial issue, and in two of them - Denmark and Ireland - referenda on the SEA were held prior to its ratification.

The main motivation behind this renewed integration movement is a common perception in the EC that European industry is falling behind the United States and Japan, especially in high tech areas such as electronics and telecommunications. It is asserted that a truly frontierless EEC will constitute a market with 320 million people, making it possible for European firms to reap economies of scale and other benefits of a large market, something that is precluded today due to the existence of different national standards, regulations, preferences for national firms in government procurement, and other non-tariff barriers[2]. Some American and Japanese business leaders and politicians, however, are worried that in addition to abolishing internal barriers, completion of the internal market will be coupled with greater protection for European industry. At this point this is speculation; however, the possibility that such a development takes place is always present[3].

The push towards integration embodied in the SEA is likely to lead to changes in many areas, some of which are not explicitly covered by the 300 directives. Because the Act aims to create a "Europe without frontiers," all national rules and regulations which constitute barriers to trade or to the movement of factors of production will potentially be affected. The two most obvious types of barriers, tariffs and quantitative import restrictions, have long ago been eliminated in intra-EC trade (although production quotas in agriculture and steel still exist). However, a long list of non-tariff barriers (NTBs) continues to impede intra-EC trade. In a 1987 survey of approximately 20,000 companies in all 12 EC countries, the different categories of NTBs were ranked as follows with respect to their seriousness as impediments to trade[4]:

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[2] "Europe's Internal Market", *The Economist*'s 1988 survey article, provides a succinct summary of European thinking on these issues.

[3] Although the apparent collapse of the Uruguay Round of the GATT negotiations was directly related to agriculture, it undoubtedly has heightened the fears of U.S. and Japanese businesses.

1. Technical standards and regulations
2. Administrative barriers
3. Border formalities
4. Freight transport regulations
5. Value-added tax (VAT) differences
6. Capital market controls
7. Government procurement restrictions
8. Implementation of EC law

The top two barriers on this list include rules such as the Danish prohibition against aluminum beverage containers or the French administrative procedures in connection with imported cars. These NTBs are being addressed through various Commission directives and legal action[5]. The abolition of border formalities is one of the major goals of the EC Commission, for both economic and political reasons. A study by the accounting firm Ernst and Whinney estimated that the direct costs associated with border formalities in connection with intra-EC trade amounted to approximately 2% of the value of that trade[6]. In addition to the economic gains resulting from free and open borders, being able to cross from one country to another without any checks is seen as an essential part of a unified Europe and thus something to be desired for its own sake.

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[4] "The Economics of 1992", p. 44.

[5] For example, recent targets include the German and Italian purity laws relating to beer and pasta, respectively.

[6] Reported in "The Economics of 1992", p. 48.

To make abolition of border controls possible, the EC Commission advocates harmonization of indirect taxes within the Community. As discussed below and in the following chapter, this alone may lead to substantial changes in some countries' tax systems and economies. But the implications of "1992" are even broader. Some authors advocate harmonization of not only indirect but also direct taxes; in the long run, it is argued, even social policy needs to be harmonized lest the countries with a highly developed welfare state be overrun by poor immigrants from less generous EC members[7]. Finally, it is an official goal of the EC Commission that the existing gaps between rich and poor members of the EC be reduced. As Mendes (1990) shows, there is considerable disparity in GDP per capita within the EC, with four countries (Greece, Portugal, Ireland, and Spain) at levels far below the average; he also argues that this inequality grew during the 1980s despite the EC's regional policy which has channelled considerable sums to the less-developed regions of the Community. In Commission (1988), it is acknowledged that completion of the internal market may result in further concentration of economic activity in already wealthy regions.

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[7] Sinn (1990) is a proponent of this view. He argues that given the free movement of people and the absence of direct tax and social policy harmonization, a country like Denmark would experience an in-migration of welfare recipients coupled with an out-migration of high-income individuals fleeing the high taxes needed to pay for generous social policies, resulting in the collapse of those policies.

One can therefore foresee that future EC initiatives will seek to narrow the intra-EC income distribution and that this goal will also affect the way policies such as the fisheries policy and the Common Agricultural Policy are conducted. In the following two sections, the implications of *1992* for tax harmonization and for agricultural policy are discussed.

Tax Harmonization in the EC

Currently, the European countries have widely varying tax systems. Table 1-1 compares the tax structures of 11 EC members.

Table 1-1. EC Tax Structure, 1986 (% of Gross Value Added).

	Income taxes	Social cont.	Indirect taxes	Corporate taxes	Other taxes	Total taxes
DEN	29.3	1.8	21.4	2.2	4.2	59.0
LUX	14.7	13.9	13.3	8.8	3.4	54.0
FRA	7.6	21.5	14.8	2.4	3.9	50.3
BEL	16.9	16.9	12.1	3.0	1.0	50.0
HOL	10.2	21.4	13.0	3.3	2.0	49.0
UK	12.7	8.2	14.1	4.6	5.9	45.5
IRE	15.5	6.4	19.9	1.7	1.7	45.5
GER	11.9	15.5	10.5	2.3	1.3	41.6
GRE	6.1	13.5	18.8	1.2	1.3	41.0
ITA	10.1	12.9	9.4	2.7	1.3	36.4
SPA	6.6	14.6	11.9	1.5	2.0	36.7

Source: Danish Economic Council (1989, p. 98).

As the table shows, three countries--Ireland, Greece, and Denmark--have very high indirect tax burdens. However, in Ireland and Greece the high average level of indirect taxes is the result of high consumption shares of the taxed goods, whereas in Denmark the high level is the result of high indirect tax *rates*. The other major difference between Denmark and the rest of the EC lies in the high Danish direct income taxes and extremely low social contributions. This tax structure is the result of a desire on the part of successive Danish governments to make the tax system progressive by relying mainly on direct income taxes as opposed to social contributions and payroll taxes.

Table 1-2 shows the Value Added Tax (VAT) rates in the EC, along with the Commission's 1987 harmonization proposal, and Table 1-3 does the same for the most important excise taxes.

Table 1-2. VAT Rates in the EC, 1987 (%).

	Reduced rate[a]	Standard rate	Higher rate[a]
DEN	-	22	-
BEL	1 and 6	19	25 and 33
FRA	2.1 and 4	18.6	33.3
GER	7	14	-
GRE	6	18	36
IRE	2.4 and 10	25	-
ITA	2 and 9	18	38
LUX	3 and 6	12	-
HOL	6	20	-
POR	8	16	30
SPA	6	12	33
UK	-	15	-
Commission proposal	4 to 9	14 to 20	-

[a] The "reduced rate" is commonly applied to necessities, the higher rate to luxuries.

Source: "The Economics of 1992", p. 61.

In addition to the differences in VAT rates, the countries differ with respect to the base. For example, in Britain necessities (food, clothing, books, drugs) are not taxed at all, while in Denmark all goods and services are taxed at the standard rate.

Table 1-3. Excise Tax Rates in the EC, 1987.

	Pure alcohol (ECU/liter)	Wine (ECU/l)	Beer (ECU/l)	Cigarettes (ECU/1000)	Gasoline (ECU/l)
DEN	34.99	1.57	0.56	77.5	0.473
BEL	12.52	0.33	0.10	2.5	0.261
GER	11.74	0.20	0.07	27.3	0.256
GRE	0.48	0	0.10	0.6	0.349
SPA	3.09	0	0.03	0.7	0.254
FRA	11.49	0.03	0.03	1.3	0.369
IRE	27.22	2.79	0.82	48.9	0.362
ITA	2.30	0	0.17	1.8	0.557
LUX	8.42	0.13	0.05	1.7	0.209
HOL	12.98	0.33	0.20	26.0	0.340
POR	2.48	0	0.09	2.2	0.352
UK	24.83	1.54	0.49	42.8	0.271
Commission proposal	12.71	0.17	0.17	19.5	0.340

NOTE: 1 ECU = $1.24 (May 1990).

Source: "The Economics of 1992", p. 63.

Besides the main excise taxes shown in Table 1-3, numerous other goods are taxed[8]. According to the Commission's proposals, those excise taxes will be eliminated.

The EC Commission views harmonization of indirect taxes as a crucial prerequisite for completing the internal market.

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[8] In Denmark, the list of goods subject to excise taxes (besides those listed in Table 1-3) includes all tobacco products, chocolate, ice cream, coffee, tea, sugar, cosmetics, mineral water, records, consumer durables, light bulbs, matches, lighters, playing cards, packing materials, freon, and electricity (Danish Economic Council (1989, p. 95)).

The Commission's view is clearly stated in many publications, for example in Guieu and Bonnett (1987): "The approximation of rates is, in the opinion of the Commission, an indispensable precondition for the abolition of frontier controls" (p. 224). Without harmonization and with open borders, widespread arbitrage would result, especially in commodities such as tobacco products which are easily transportable. Such cross-border shopping could cause severe difficulties for retailing in border regions (on the high-tax side) as well as drain tax revenues in the high-tax country. In addition, even though excise taxes are applied equally to domestic and imported goods, it is obvious from Table 1-3 that they are being utilized as a subtle form of protectionism. For example, it is not a coincidence that Greece, Spain, France, Italy, and Portugal (all major wine producers who are not exactly known for the quality of their beer) have either extremely low taxes on wine or none at all while taxing beer; conversely, Denmark, Belgium, Germany, Ireland, and Britain tax wine at about three times the rate of beer. Likewise, Denmark, a country without an auto industry, has the second-highest gasoline tax in the EC, as well as a 180% excise tax on automobiles.

Accordingly, the Commission has proposed the following steps to achieve a unified regime of indirect taxes[9]:

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[9] Pelkmans and Winters (1988, p. 94-95) summarize the Commission's August 1987 proposals for fiscal harmonization. The papers contained in Cnossen (1987) provide the most thorough review of tax issues in the EC context.

1. Complete harmonization of VAT base
2. A band of VAT rates of 4-9% for necessities (food, clothing, books, etc.) and 14-20% for other goods.
3. Complete harmonization of excise taxes on tobacco, alcohol, and energy.
4. Abolition of other excise taxes.

It is obvious from Tables 1-2 and 1-3 that the Commission's proposals would require Ireland and Denmark to make significant downward adjustments in their indirect tax rates while especially Luxembourg would have to raise its rates.

The opinion that indirect tax rates must be harmonized is not universally shared, however. Bos and Nelson (1988) argue that harmonization of VAT rates is not strictly necessary because transport costs would prevent significant cross-border shopping by individuals, while differences in VAT rates matter little for a firm's decision where to buy inputs since VAT on purchased intermediate products is refunded. On the other hand, excise taxes must be harmonized according to Bos and Nelson, since the low transport cost per unit along with the wide disparities in rates would make cross-border shopping very attractive. Smith (1988) goes even further in arguing that even harmonization of excise taxes is not essential. He, along with other proponents of the "let-the-tax-systems-compete" view, points out that all the costs of cross-border shopping fall on the high-tax country[10]. Consequently, countries with high taxes have a strong incentive to lower their tax rates to levels comparable to those of their neighbors. According to this school of thought, the only EC regulation needed in this area is the setting of *minimum* excise tax rates to prevent countries like Luxembourg from taking too much business from heavily populated neighbors. This *laissez-faire* view is further strengthened by the realization that the rates proposed by the Commission are not purported to be optimal in an economic sense; rather, they are what the Commission judged to be politically feasible, in most cases some sort of average of existing rates. However, regardless of the disagreement between the Commission and the "free-marketeers", there can be little doubt that indirect tax rates in the EC will be harmonized within the next few years, either through EC law or market pressures.

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[10] These costs include (1) lost government revenue, (2) resource costs of longer shopping trips, and (3) the loss of business for retailers in the high-tax border region.

So far, formal tax harmonization proposals in the EC have been limited to indirect taxes. It has been argued that since capital is even more mobile across frontiers than goods and services, harmonization of taxes on capital (e.g., the corporate income tax) is necessary[11]. This view has gained more urgency in recent years, as restrictions on international capital flows have been eased in most countries. For example, Musgrave (1987), Alworth (1987), and others have proposed complete harmonization of corporate tax rates, stressing that both the rates and (especially) the tax bases need to be uniform in order to ensure locational neutrality of capital taxation. However, the European countries have so far shown little political will to follow this route. Nevertheless, according to Matthiesen (1990), market pressures will eventually force the needed adjustments.

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[11] Danish Economic Council (1989, p. 99).

Until now, there has been little perceived need to harmonize personal income taxes. The conventional wisdom has been that labor is rather immobile due to cultural differences, language, etc. However, as Matthiesen (1990) points out, this is not true for all categories of labor. Important groups of highly skilled workers probably have an above-average willingness to emigrate in pursuit of higher wages and/or lower income taxes. The degree of labor mobility in the EC is likely to increase in the future as the cultures of individual countries become increasingly internationalized and barriers to labor mobility are lowered through EC legislation such as directives requiring mutual acceptance of professional degrees from other EC countries. In such a situation, a country like Denmark, with its high income tax rates and free education from kindergarten through graduate school, might find itself educating, say, physicians and engineers, only to see them emigrate upon receipt of their diplomas. Thus, even though emigration to low-tax countries may be limited by non-economic barriers and by the fact that services provided collectively are also an argument in an individual's utility function, there is likely to be increasing pressure toward income tax harmonization in the EC.

EC's Agriculture Policy

One of EC's early major accomplishments was the establishment of the Common Agricultural Policy (CAP) during the early part of the 1960s. By 1964, 85% of agricultural production in the EEC was covered by the CAP[12], rising to 91% in 1984[13]. The Treaty of Rome defines five broad goals for the CAP: (1) to increase productivity in European agriculture, (2) to ensure an adequate standard of living for rural populations, (3) to stabilize the markets for agricultural products, (4) to ensure an ample food supply and, (5) to maintain reasonable prices for the consumers. These goals are partly distributional in nature (to ensure an "adequate" income for farmers) and partly structural (to facilitate movement of labor and capital from agriculture to other sectors). In the actual formulation of policy, the goal of raising farmers' incomes has clearly dominated. This is sought accomplished through a system of external tariffs and export subsidies. Figure 1-1 shows the basic operation of the scheme. For most commodities, each year the Council of Agriculture Ministers sets a target price and an intervention price. When agricultural products are imported into the EC, they are

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[12] Hansen (1977, p. 157).

[13] Østrup and Kristensen (1986, p. 157).

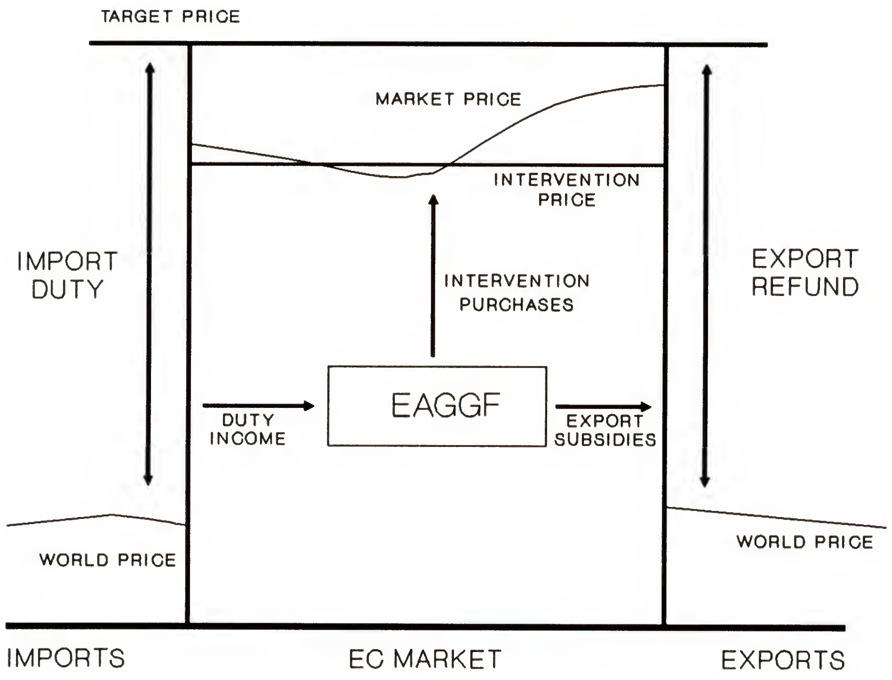

Figure 1-1. Basic Operation of the CAP.

subject to a variable import duty equal to the difference between the target price and the (usually lower) world price[14]. The revenue from the import duties is passed on to the European Agricultural Guidance and Guarantee Fund (EAGGF). The EAGGF uses its funds in two ways. First, whenever the market price within the EC falls below the intervention price, EAGGF buys the excess supply - hence the infamous "butter mountains" and "wine lakes". Second, when agricultural products are exported to countries outside the EC, EAGGF pays the exporter an export refund equal to the difference between the internal EC market price and the world price. In 1988, this scheme cost the EC 27 billion ECU and accounted for 68% of the Community's total budget[15].

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[14] The actual import duty is slightly lower, because the target price is reduced by the transport cost between Duisburg, Germany, and Rotterdam, Holland. The resulting price is known as the "threshold price". Similar adjustments are made in the computation of the export refunds.

Compared to agricultural support schemes in most other major countries, the CAP stresses price support rather than production quotas or direct income support for farmers. As a result, prices of agricultural products within the EC are well above world prices[16]. Due to the stimulative effect on production, the Community has attained and surpassed self-sufficiency in most agricultural products, a situation exacerbated by the addition of Spain and Portugal in 1986.

Numerous studies have attempted to estimate the economic costs of the CAP. For example, general equilibrium studies of worldwide agricultural support policies reviewed by Winters (1987) indicate deadweight losses between 0.2% and 2.7% of GDP in various countries, with EC and Japan tending toward the higher end of the estimates. In their review article, Demekas et al. (1988) contend that the results in the high range are more reliable because they are based on more sophisticated models with a higher degree of disaggregation. These deadweight losses reflect costs to consumers and taxpayers which outweigh the gains to producers, but they ignore the value of the additional resources expended in various rent-seeking activities. In a general equilibrium framework, agricultural support also hurts industries other than agriculture by raising input prices and thus negatively affecting their international competitiveness[17].

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[15] OECD (1989, p. 82).

[16] For example, in 1980-81 the excess of the EC price over the world price was 46% for wheat, 90% for beef, 35% for pork, and 186% for butter (Sørensen and Pultz (1986, p. 55)).

Defenders of the CAP often contend that the welfare losses are a small price to pay, given the worthy objectives of increasing and stabilizing farm income, preserving a rural way of life, ensuring stable food supplies, etc. However, much available evidence suggests that the CAP is not the best instrument to achieve those goals. Any rise in farm incomes due to the CAP has usually been capitalized into land prices and thus benefitted only existing farmers in proportion to the size of their holdings[18]. Concerning price stability, all the studies of this issue summarized in Rosenblatt et al. (1988) conclude that the CAP has contributed to world price instability. This occurs because the CAP insulates EC consumers from world price swings and thereby removes any incentive to take actions which might have countered the price movements; also, protection has reduced private incentive to hold buffer stocks which ordinarily would have had a damping effect on price variations.

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[17] In view of this, it is puzzling that a country like Germany has been a staunch defender of the CAP.

[18] As discussed in the next chapter, this happened in Denmark during the 1970s.

From a distributional standpoint, the CAP is regressive on several levels: high food prices hurt low-income households the most; large farmers benefit more than small ones; and finally, because northern products such as grain, dairy, and beef receive higher subsidies than Mediterranean products such as fruits and vegetables, the CAP benefits the already richer northern countries more than the poorer EC members in the south.

In addition to its effects on EC consumers and producers, the CAP also has an impact on the rest of the world. By stimulating EC exports far beyond the level that would prevail in a free-trade regime, the CAP depresses world prices. The most comprehensive study of this effect, Tyers and Anderson (1986), estimates that abolition of the CAP would increase world wheat prices by 6%; coarse grain prices by 5%; rice prices by 3%; beef and lamb prices by 18%; pork and poultry prices by 4%; sugar prices by 7%; and dairy product prices by 25%. Obviously, large agricultural exporters such as the United States, Australia, and Argentina would benefit greatly from abolition of the CAP or a reduction in EC support prices. Therefore, these countries, particularly the United States, are pushing hard for CAP reform in the ongoing GATT negotiations.

Given the external pressure on the EC to reform the CAP, the substantial negative welfare effects on EC economies, and the heavy burden it imposes on the EC budget, it is not surprising that various EC bodies have produced numerous proposals for reform during the last 30 years[19]. However, little actual action has been taken by the Community. During the 1980s, limited reforms were instituted: a quantitative limitation on grain took effect in 1982, with lower guaranteed prices for output above the maximum; in 1985, Community-wide production quotas on dairy products were introduced. In addition, "co-responsibility levies" shift a small part of the cost of intervention onto producers. Taken together, these changes have had little effect on the persistent excess supply.

Nevertheless, despite the seeming impossibility of reforming the CAP, it is indeed likely that significant changes will take place in the coming years. Several factors increase the probability of substantial CAP reform: the external pressure applied by the United States and other food exporting countries may lead to liberalization[20]; consumers in the EC may demand lower food prices; the new members of the EC in Southern Europe may demand that the CAP be restructured to favor their crops; and the desire on EC's part to expand its policies in new areas (e.g., the environment) may produce an impetus toward reducing the level of EAGGF expenditures.

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[19] The history of CAP reform proposals is outlined in Fennell (1987). She is somewhat pessimistic about prospects for meaningful reforms due to the strength of the farm lobby and the institutional arrangement whereby prices are set by agriculture ministers who tend to focus on the narrow interest of the agricultural sector.

[20] Clearly, with its offer to reduce agriculture subsidies by 30% in the GATT negotiations, the EC has signalled its acceptance of the need for reform.

Overview of the Study

Following this introductory chapter, Chapter 2 summarizes the Danish perspective on European integration, with particular emphasis on tax harmonization and the CAP. In Chapter 3, after a brief discussion of computable general equilibrium (CGE) models and their applicability to indirect tax harmonization and agricultural policy reform, a model of the Danish economy is specified and calibrated. This model is then used to simulate the effects on Denmark's economy of indirect tax reductions and abolition of the CAP. The results of those experiments are presented and interpreted in Chapter 4. The sensitivity of the results to the key parameter assumptions is also examined. Chapter 5 discusses the policy implications of the simulations and contains concluding remarks and suggestions for further research.

CHAPTER 2
A DANISH PERSPECTIVE ON EUROPEAN INTEGRATION

Historical Overview

Traditionally, Denmark's two most important trading partners have been Great Britain and Germany, respectively. In 1964, 39% of all Danish exports and 67% of agricultural exports went to these two countries[1]. While Germany was one of the founders of the EC, Great Britain initially chose to remain outside due to its lack of enthusiasm for the idea of European political union. Instead, Britain took the initiative in the formation of the European Free Trade Association (EFTA) in 1960, consisting of Britain, Sweden, Norway, Denmark, Switzerland, Austria and Portugal. The EFTA free trade rules, however, did not include agriculture, although Denmark was able to achieve substantial tariff reductions through bilateral agreements with Britain and Sweden.

The fact that each of Denmark's two principal export markets now belonged to a different trade block created a very serious problem, especially in agriculture, where the high tariffs resulting from EC's agricultural policies limited Denmark's access to the German market despite the relatively strong international competitiveness of Danish agriculture.

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[1] Johansen (1980, p. 42-43).

Thus, when Britain decided to apply for admission to the EC in 1961, Denmark eagerly followed. However, Britain's application was blocked by France in 1963, leading Denmark to cancel its own application. A second attempt at negotiations begun in 1969 was more successful, and Britain, Denmark and Ireland joined the Community on 1 January 1973.

For Denmark the motivation for joining the EC had always been purely economic. The question of access to the European markets was of paramount importance for this small open economy. The Danes have always been uneasy about the political aspects of the EC, especially with respect to its professed ultimate goal of a European union. In 1972 there was broad consensus about the economic advantages of following Britain into the EC; however, there was also growing concern about the loss of sovereignty and national identity that membership could entail in the long run. Most Danes were very interested in the free trade aspect of membership, much less so in the integrationist ideas being tossed around in Brussels. To resolve the issue, a referendum on the accession to the EC was held in October 1972. It was preceded by intense debate[2] and resulted in a 63% yes vote. Nevertheless, opponents of EC membership continued their political activity after 1972. Initially their aim was to reverse the 1972 decision, but as time went on they turned their attention to attempts at slowing down the process of European integration. Since each member country had veto power over all substantial EC decisions, this goal could be accomplished through pressure on the Danish government.

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[2] Worre (1988) provides a summary of the debate and an analysis of the political situation prior to the referenda in 1972 and 1986.

In Denmark, the 1970s were characterized by widespread disappointment with the results of EC membership. There was a prevailing sense that the economic advantages of joining had been overstated by the proponents of EC in 1972. There is no doubt that the popular expectations were overly optimistic. Many Danes believed that access to the continental markets would make a solution of the macroeconomic balance problems (especially the persistent trade deficit) possible without requiring any reductions in consumption. Expectations of an increased volume of agricultural exports at high prices led to large investments in agriculture and a steep increase in farm prices following 1972. This resulted in a wave of foreclosures on debt-burdened farms in the late 1970s when land prices began to fall. The overall economic situation was complicated by the oil crisis in 1973-74 and the ensuing recession. Danish industry was particularly ill prepared for an international crisis. During the last two years of the economic boom of the early 1970s Denmark's international competitiveness had been severely eroded due to increasing labor costs[3]. The macroeconomic problems have continued throughout the 1970s and the 1980s, although the trade balance has improved in recent years. Dissatisfaction with the Community continued; until 1985, most opinion polls showed that the Danes, if given the chance to decide again, would not have voted to join the EC.

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[3] In 1973, for example, average wages in manufacturing increased by 20% (Hansen (1977, p. 211)).

Given this background, the Single European Act became a contentious issue in Denmark. The debate leading up to the referendum, rather than being a debate on the merits of the Act, became a debate on the EC membership itself, with proponents of the SEA arguing that if Denmark rejected the Act it would sooner or later leave the EC. The opposition to the SEA centered mainly around the question of the weakening of national sovereignty due to the loss of veto power in some matters. As in 1972, the "pro-Europeans" focused on the economic advantages of EC while the "anti-Europeans" stressed the political costs. In the 28 February 1986 referendum the SEA was approved with 56% of the vote.

As the above discussion indicates, Denmark has always been a somewhat reluctant participant in the process of European integration. Even after having approved the SEA in 1986, the main concern for the Danes was to minimize the loss of national sovereignty. Unique among the 12 member countries, and somewhat paradoxically, Denmark elected representatives from *The People's Movement Against The EC* to the European Parliament. There was widespread concern that EC directives in connection with the *1992* program would force Denmark to abandon its tough environmental standards, its pro-labor worker protection laws, and, ultimately, large elements of its welfare state in favor of a "lowest common denominator" represented by the Mediterranean countries[4].

However, a marked shift in the tenor of public debate occurred in 1989 and 1990. Denmark basically abandoned its attempts to slow down integration; instead, the new attitude is that a much closer economic and political union is now inevitable, and that the task at hand is to ensure that Danish concerns and principles are adequately reflected in future revisions of the Treaty of Rome and EC policies in general. Danes tend to look favorably on Commission proposals put forth under the leadership of French Socialist Jacques Delors such as the "Social Dimension" program under which all Community members would have at least a minimum level of social and health policy and worker-protection laws. At the same time, Danish politicians and economists are considering their country's options for dealing with tax harmonization and other consequences of the completion of the internal market. I now turn to a discussion of some of those options.

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[4] One typical event which heightened Danish worries was a case brought against Denmark by the EC Commission in the European Court of Justice in 1986. The Commission contended that the Danish law requiring recyclable beverage containers and a deposit system constituted an unfair impediment to imported beer and soft drinks. In 1988 the Court ruled against the Commission and allowed Denmark to keep its law. This case set an important precedent in establishing the primacy of environmental and health standards, even when they impede trade. Among other things, in 1990 it enabled Denmark and Holland to adopt U.S. auto emission standards on their own.

Danish Options for Tax Harmonization

As shown in Chapter 1, compared to most other Western countries, Denmark has a relatively greater reliance on direct income taxes, the VAT, and excise taxes; on the other hand, the Danish government derives only small amounts of revenue from corporation taxes and social contributions by employees and employers.

It is clear from Tables 1-2 and 1-3 that the tax harmonization proposals set forth by the EC Commission involve substantial decreases in Danish indirect tax rates. The standard VAT rate would decline from 22% to 20% (a 9% drop) for most goods, and all the way down to 9% (a 59% drop) for food, clothing and other necessities which together accounted for 27% of private consumption expenditure in 1988[5]. The proposed reductions in excise tax rates are 28% on gasoline, 64% on hard liquor, 89% on wine, 70% on beer, and 75% on cigarettes - commodities which account for another 9% of consumption. In addition, all the miscellaneous excises listed in footnote 8 in Chapter 1 would be abolished. The Danish Ministry of Taxation estimates that these changes amount to a cut in indirect taxes of almost 40 billion DKR using 1988 prices and quantities, or 29% of total indirect tax revenue[6]. Of course, increased economic activity would make the final revenue loss somewhat less. Nevertheless, the decline in tax revenues would be very substantial.

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[5] Danmarks Statistik (1989, Table 22).

[6] Cited in Greve (1989, p. 54).

Thomsen (1989) summarizes five basic possibilities for adaptation to the lower indirect tax rates:

1. *Reduce indirect taxes without any compensating policy changes*. This option is not considered to be feasible for two main reasons: the large increase in households' disposable income would increase Denmark's chronic current account deficit, and the massive tax cut would lead to a government budget deficit of unacceptable proportions.
2. *Compensate by increasing income taxes*. While possible in principle, this solution is problematic in practice since Denmark already has the highest income tax rates in the EC. In recent years, the trend in most OECD countries has been toward lower income tax rates[7]. As discussed in the preceding chapter, the increasing degree of labor mobility in the Community may well necessitate that Denmark bring its income tax rates more in line with the rest of the EC. Indeed, competing proposals to lower the top income tax rate are already on the political agenda in Denmark. Hence, any increase in income taxes to

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[7] Table 7 in Matthiesen (1990) shows that between 1986 and 1989, 22 of the 24 OECD countries lowered their marginal income tax rates, while two countries kept their rates constant.

compensate the Treasury for lost indirect tax revenues must be judged completely improbable.

3. *Compensate by instituting a consumption tax.* This possibility is quite popular in Danish academic circles. However, it is fraught with practical difficulties; issues which immediately come to mind are: the treatment of consumer durables, the adjustments in connection with immigration and emigration, and the amount of detailed information on taxpayers' consumption and wealth necessary to implement such a tax. This option has therefore been largely ignored by policy makers.
4. *Compensate by raising employees' and employers' social contributions*. In the process, the overall Danish tax structure would become more similar to those of other EC members. The opposition against this route is based on the fear that it would reduce the international competitiveness of Danish industry, and on the perceived regressiveness of such levies. In addition, labor market reforms currently being planned for purely domestic reasons already involve raising these levies; hence, the scope to use them to compensate for EC-mandated indirect tax cuts is limited.
5. *Compensate by cutting government spending*. Assuming that the indirect tax cut amounts to the 40 billion DKR figure mentioned above, this implies reducing government

spending by about 9%[8]. Given the record of successive Danish governments in their attempts to hold down the growth of public spending, it is doubtful that spending cuts of this magnitude would be politically acceptable. Thus, none of the strategies outlined here appear likely to be implemented in its pure form; rather, a mix of them will be utilized, for example, some reduction in government spending coupled with an increase in social contributions. One should also not discount the very real possibility that indirect taxes will not be harmonized to the extent suggested by the EC Commission. Frequently, non-economic as well as economic motives lie behind particular taxes; it is difficult to imagine that Denmark would lower its cigarette taxes by 75%, given the current concerns about smoking and health. Likewise, due to environmental concerns Denmark is also likely to retain relatively high gasoline taxes. However, in the simulations in Chapter 4, complete adherence to the Commission proposals is assumed. Those simulations thus provide a benchmark against which less extreme tax changes can be evaluated.

Besides the indirect taxes which are the focus of this study, Denmark also deviates from other EC countries in the way capital income is taxed. As mentioned in Chapter 1, due to the high international capital mobility, harmonization of capital taxation may be even more urgent than harmonization of indirect taxes. The only concrete harmonization initiative from the Commission to date consists of a proposal to withhold 15% of interest income throughout the Community. Even this relatively modest proposal has met with a chilly reception in several countries[9], so harmonization is more likely to come about as a result of market pressures than concerted EC action. This poses a threat to yet another revenue source for the Danish government - the so-called *real interest tax* on private pension funds. This tax, unique in the EC, is designed so as to limit pension fund yields after taxes and inflation to 3.5% annually and brought in about 19 billion DKR in 1989, or between 3% and 4% of total government revenue. Since 1 October 1988, Danish citizens have been able to open retirement accounts in other countries. Even though they can only deduct payments into the pension plan on their income tax returns if the real interest tax is paid, simple calculations show that it is often more profitable to give up the tax deductibility of payments and escape the real interest tax, especially for younger people[10].

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[8] In 1988, total government spending was 441.1 billion DKR (Danmarks Statistik (1989, Table 1)). Of course, the 9% reduction is based on a calculation which assumes unchanged consumption patterns and prices and thus ignores any positive effects on economic activity resulting from the tax cuts. Quantification of such effects is one of the purposes of the simulations reported in Chapter 4.

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[9] One factor which complicates the prospects for action on capital taxation is the fact that liberalization of capital flows extends to countries outside the EC. Hence, Luxembourg, one of the strongest opponents of the 15% withholding tax and of harmonization in this area in general, argues that any such move (as well as proposed rules for lessening bank secrecy in order to counter tax evasion) would merely result in a shift of capital from banks and other financial institutions within the EC to those in Switzerland, Monaco or the Bahamas.

In summary, the Danish government stands to lose between 10% and 15% of its tax revenue during the coming few years as a consequence of the *1992* project and related changes. To absorb such an erosion of the tax base while maintaining the basic structure of the welfare state (about which there is broad political consensus in Denmark) promises to be quite a challenge indeed.

The Common Agricultural Policy and Denmark

Throughout this century, agriculture in all the industrialized countries has faced the same basic problem: because the income elasticity of demand for food is less than 1, as incomes have risen, the share of total consumption spent on agricultural products has declined. To make matters worse, productivity advances also contributed to the imbalance between supply and demand. The result has been falling relative output prices and factor incomes which did not measure up to those earned in the rest of the economy. In an efficiently functioning market, the usual consequence of such a development is factor migration to other sectors until factor rewards in the declining sector rise to a level comparable to the surrounding economy. Indeed, this did occur in agriculture to some extent. However, the falling rural incomes also led to demands for government action, demands which were frequently met. The explanation of the special treatment traditionally accorded agriculture while other industries have been allowed to wither is beyond the scope of this study. At any rate, today agriculture does receive some form of government assistance in virtually all Western countries.

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[10] See Matthiesen (1990) for sample calculations.

Denmark is no exception to this pattern. During the 1950s and 1960s a set of policies designed to support agriculture was developed. It included price regulation, governmentally sanctioned producer cartels, direct income supplements for farmers, and rather stringent quantitative restrictions on imports[11]. Nevertheless, the agriculture sector continued to decline, partly due to diminishing market access on the European continent as EC's Common Agricultural Policy with its high external tariff walls was instituted. Since between 60 and 70% of output was exported, the CAP was viewed as a serious threat. Between 1960 and 1972, real gross value added in Danish agriculture declined at an annual rate of 1%[12].

With this background, Denmark's desire to join the EC was mainly motivated by the prospect of being able to export agricultural products to European markets at high, guaranteed prices and to the rest of the world with export subsidies from Brussels. Thus, in the fall of 1971, the Danish Economic Council estimated that agricultural exports would increase by about 30% between 1972 and 1977[13].

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[11] For a detailed description of Danish agricultural policy in the postwar era, see Mogensen (1975). The national farm aid programs were phased out following Denmark's accession to the EC in 1972. More recent developments are discussed in Linderoth (1985).

[12] Linderoth (1985, Table 4.4).

Indeed, following Denmark's accession to the EC, the fortunes of agriculture changed dramatically. The real gross value added decline of the 1960s turned into an annual increase of 3.2% between 1972 and 1982[14], and agricultural exports rose sharply[15], although agriculture's share in total exports continued to fall. As might be expected, the improved profitability of agriculture gave rise to a boom in land prices between 1973 and 1978, yielding considerable capital gains for those farmers who were already established but making it very expensive for younger farmers to get started. The bubble burst in 1979, and, during the following three years, farm values fell by 15% annually[16]. Coupled with rising interest rates, this led to a wave of foreclosures.

Despite this temporary setback, there is no doubt that Danish agriculture has gained considerably from the CAP, as have other large agricultural export sectors in Holland,

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[13] Danish Economic Council (1971, p. 32).

[14] Linderoth (1985, Table 4.4).

[15] In quantity terms, meat exports rose 41% between 1975 and 1982 while exports of dairy products and eggs rose 33% during the same period (Wildt and Johansen (1985, Table IV.18)).

[16] Linderoth (1985, p. 144).

France and Ireland. Some attempts at quantifying these gains have been made. One can start with the EAGGF amounts paid to Denmark; in 1984, the total was 7205.6 million DKR, composed of 4929.7 million in export subsidies, 1640.8 million in home market subsidies, and 635.1 million in intervention expenses (i.e., losses on products sold from EC stocks, storage expenses etc.)[17]. Of course, as Ølgaard (1987) points out, the main source of gains to Danish agriculture is the ability to sell products at high prices to other EC countries, which is not reflected in the EAGGF budget. Ardy (1988) estimates the total gain to Danish agriculture from the CAP to be in the order of 2.5% of GDP, or around 15 billion DKR[18]. Only Ireland's gain is relatively higher, mostly due to that country's much greater dependence on agriculture and low GDP.

Ardy's result points to potential problems for the CAP as seen from a Danish point of view. It has not gone unnoticed among Denmark's partners in the Community that the incidence of the CAP is such that one of the three wealthiest member countries reaps some of the greatest gains. As mentioned in Chapter 1, there are considerable internal and external pressures on the EC to reform the CAP. The demands by agricultural exporters outside the EC for reduced CAP export subsidies coupled with the ever-increasing budgetary burden of the scheme will effectively put a ceiling on total CAP expenditures in coming years. At the same time, low-income countries on the Community's periphery are demanding increased intra-EC transfers, both explicitly through the regional funds and implicitly through reorientation of the CAP toward their products (this is especially true of Spain, Portugal, and Greece, whose products - mainly fruits and vegetables - have until now enjoyed much weaker protection under the CAP than meat, dairy, and grain). In many of those countries, increased direct and indirect economic aid from the richer EC members is viewed as the reward for their acceptance of the Single European Act and the opening of their markets. For example, McAleese and Matthews (1987) in presenting the Irish point of view express a concern that the Commission will force Ireland to abandon its extensive state aid to industry; hence, they demand that EC's regional policy as well as the CAP be more sharply targeted toward Ireland and other low-income countries.

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[17] Danmarks Statistik (1985, Table 16.2). These amounts refer to the Guarantee Section of the EAGGF; in addition, small amounts were disbursed through the Guidance Section (the Guidance Section aid is designed to promote structural improvements in agriculture in low-income areas of the Community and is thus of limited relevance to Denmark). The subsidies are partly offset by co-responsibility levies on dairy producers, but the total net subsidy to Danish agriculture in 1984 was still in excess of 7 billion DKR.

[18] It must be stressed, however, that Ardy does not assess the impact of the CAP on the economy as a whole. His estimates of agricultural gain are calculated as the sum of EAGGF transfers and the difference between EC and world prices multiplied by net exports. They ignore the negative impact of high food prices on consumer welfare and the distorting effect on other sectors via higher factor prices.

Another indication of possible CAP reform is the 1989 proposal from the Socialist Group in the European Parliament, summarized in de Veer (1989). This proposal would essentially abolish the CAP by scrapping its price-support mechanisms. EC prices would be allowed to fall to world levels, and any aid to farmers would take the form of direct income support, financed in part nationally and in part by the Community, depending on the country's "ability to pay", i.e. GDP per capita. Based on partial equilibrium analysis, and assuming a 20% decline in EC agricultural prices following CAP liberalization[19], de Veer estimates that Danish farmers would suffer a loss in income equal to 22% of value added, while the impact on the economy would be a loss of 0.19% of GDP[20]. According to de Veer's calculations, Ireland and Holland would also lose under the Socialist proposal. A similar partial equilibrium analysis was carried out by Thomson (1989), using a very disaggregated model. The impact of complete CAP liberalization on Denmark was also negative in this study, namely -0.79% of GDP. Again, there is a net loss because the producers' loss more than offsets the consumers' and taxpayers' gains.

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[19] Since de Veer assumes that current world prices are 40% below EC prices, this implies that CAP liberalization would cause world prices to increase by 33%, a somewhat larger impact than in most other studies.

[20] The loss to agriculture is 0.95% of GDP; the gains to consumers and taxpayers are 0.39% and 0.37%, respectively, for a net loss of 0.19%.

Danish politicians and economists as well as the general public have historically tended to focus on the advantage accruing to the agricultural sector from EC policies rather than on the total effect of those policies. In particular, as both Ølgaard (1987) and Nielsen (1983) note, the costs borne by consumers through high food prices have seldom been mentioned. This probably is a reflection of the strength of the agriculture lobby and the importance of the rural tradition in Danish culture[21]. However, it appears that now there is a recognition in Denmark that the Common Agricultural Policy is likely to be reformed in the coming years, and in this context "reform" means lower prices for Danish agricultural products. In fact, Larsen (1988) concludes that Denmark ought to concentrate not on trying to maintain high prices for its products but on preserving access to its export markets.

Given the important role played by the prospect of higher agricultural exports in Denmark's decision to join the EC in 1972, it is somewhat surprising that no formal Danish analyses of the CAP's effects on the economy (or those of other EC policies, for that matter) have been published to date. Danish Economic Council (1971) is still the most comprehensive study in this area, but it suffers from a lack of even partial equilibrium analysis; for example, the advantages for Danish agriculture were estimated using 1970-71 quantities and the then new, higher EC prices. As such, this study, in the words of Nielsen (1983), is "more bookkeeping than real economic analysis" (p. 151). Since the adoption of the Single European Act in 1986, many articles and books on its implications for Denmark have appeared, but the analyses contained in them are invariably either purely verbal or so rudimentary that they may best be characterized as educated guesses. Furthermore, due to the political sensitivity of the issue of European integration in Denmark, the authors' conclusions are often more a reflection of their attitude toward EC in general than of a rigorous and objective investigation of policies and their effects. The purpose of this study is to begin remedying that deficiency.

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[21] Denmark was much slower to industrialize in the 19th and early 20th centuries than most of its European neighbors.

CHAPTER 3
A COMPUTABLE GENERAL EQUILIBRIUM MODEL FOR DENMARK

In this chapter, I describe the model which was used to generate the results to be presented in Chapter 4. The chapter is divided into three major sections. The first section contains a brief methodological sketch of applied general equilibrium modeling[1] and an overview of some applications of the methodology of particular relevance to this study. In the second section, the equations of the CGE model of the Danish economy and the behavioral assumptions are presented. The third section describes the implementation of the model using a Social Accounting Matrix for 1984 and the GAMS/HERCULES programming language.

Overview of Applied General Equilibrium Models

Economists began attempts to operationalize the traditional Walrasian paradigm and apply it to actual economies already in the 1950s. The best-known early work is probably Harberger's 1962 article on the incidence of the corporate income tax in the United States. Although his model is extremely simplified[2], Harberger's basic methodology has had a profound influence on later work. Two methodological innovations stand out: first, Harberger's treatment of the corporate income tax as an *ad valorem* tax on capital demonstrated how complex real-life taxes can be transformed into a model-equivalent form and thus analyzed; second, the convention of defining units of goods and factors of production such that their price is 1 in the benchmark equilibrium has been followed in most later AGE studies, including the present one.

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[1] The terms "applied general equilibrium" (AGE) and "computable general equilibrium" (CGE) appear to be used interchangeably in the literature. I prefer the term CGE to denote models which are complex enough so as to render an analytical solution impossible in practice, in contrast to simple two-sector models such as Harberger (1962) or Jones (1965) which are indeed applied and can be solved analytically.

The first multisector CGE model was constructed for the Norwegian economy by Leif Johansen in 1960[3]. Johansen's method consists of expressing the model in percentage rates of change rather than levels, thus producing a linearized system of the form Av=0, where A is a (N*M) matrix of elasticities and v is a M-dimensional vector of percentage changes[4]. In this system, there are more variables than equations, i.e. M>N; after specification of M-N exogenous percentage changes, the model can be solved by matrix inversion. This has the advantage of mathematical and computational simplicity (relatively speaking!), but as always, when approximating nonlinear with linear functions, an approximation error occurs. This error limits the usefulness of Johansen-style models when the policy changes being analyzed are of a large magnitude[5]. However, since the model is mathematically linear, it is easier to solve than nonlinear models (see below), which made it possible to construct and solve very large models already in the 1960s. Johansen-style models continue to be used today; prominent examples are the large Australian ORANI model (Dixon et al., 1982), containing 113 industries, 115 commodities, and 9 labor categories, and the Norwegian MSG model (Lorentsen and Skoglund, 1976).

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[2] Harberger's model has two producing sectors (corporate and non-corporate), one consumer, a closed economy, and a balanced government budget.

[3] Described in Johansen (1973).

[4] N is the number of equations, and M is the number of variables in the model.

A second distinct style of CGE modeling has come to be known as the Shoven-Whalley style of model, reflecting the many contributions of John B. Shoven and John Whalley, starting in the early 1970s. This line of research was made possible by Scarf's (1973) formulation of a solution algorithm based on Brouwer's fixed point theorem which also figures prominently in the proof of existence of a competitive equilibrium (Varian [1984, p. 195-196]). The advantage of Shoven-Whalley models is that they are expressed in levels and avoid the linearization error of Johansen's method. Advances in computer technology since the 1970s have greatly reduced the computational problems of finding equilibrium of a nonlinear system. In their 1984 overview article, Shoven and Whalley were thus able to state that "it is no longer the solution methods that constrain model applications, but the availability of data and the ability of modelers to specify key parameters" (1984, p. 1021). This is even more true today, as off-the-shelf solution programs such as GEMPACK and HERCULES have become available, and technology has advanced to the point where quite substantial models can be easily solved on a personal computer[6]. Judging from the multitude of CGE applications published during the last decade, a majority of modelers today work in the Shoven-Whalley framework.

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[5] Methods exist, however, for elimination of the approximation error. They have been applied in the Australian ORANI model; see Dixon et al. (1982, p. 51-54).

All CGE models have certain features in common. On the most basic level, a CGE model is a system of demand and supply equations for all goods and factors of production. Depending on the scope of the model, the agents whose behavior is modeled usually include consumers, producers, the government, and the rest of the world. Of course, the models differ greatly in their sophistication and size, but ultimately every model is reduced to a system of excess demand equations, and the equilibrium condition of zero excess demand in every sector yields a market-clearing price vector as the solution of the model. In practice, numerous other questions arise; for example, the modeler needs to choose a numeraire or normalize prices around some price index because of Walras' Law, and the question of macroeconomic closure must also be decided on. These issues will be dealt with in the next section.

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[6] GEMPACK was developed at the Impact Project in Australia for use with ORANI and other Johansen-style models (see Codsi and Pearson (1988)). HERCULES has its origins at the World Bank and is used with Shoven-Whalley models. It was utilized in this study and is described below in connection with the implementation of the model.

Once the basic structure has been chosen, the process of setting up and using a CGE model for policy analysis may be summarized as shown in Figure 3-1 (adapted from Shoven and Whalley, 1984).

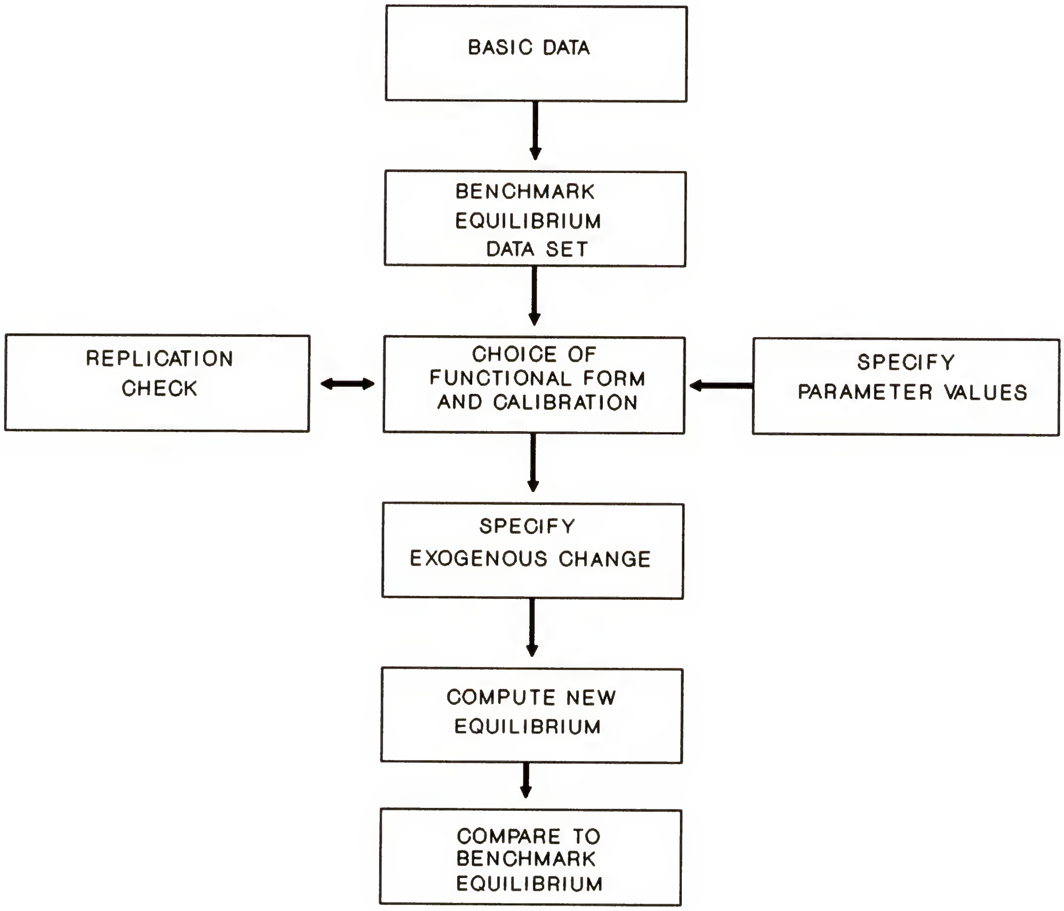
BASIC DATA
BENCHMARK EQUILIBRIUM DATA SET
REPLICATION CHECK
CHOICE OF FUNCTIONAL FORM AND CALIBRATION
SPECIFY PARAMETER VALUES
SPECIFY EXOGENOUS CHANGE
COMPUTE NEW EQUILIBRIUM
COMPARE TO BENCHMARK EQUILIBRIUM

Figure 3-1. CGE Modeling Flowchart.

The basic data needed for a CGE model includes the national account statistics, input-output tables, trade and tax data, balance of payment statistics, and consumption data for the base year. After collecting this information, one frequently finds that the various data sources are inconsistent: for example, sectoral imports and exports from trade statistics or the input-output tables do not match the balance of payments data, the household consumption data do not add up to the number shown in the national accounts, and so on. Creation of a benchmark equilibrium data set involves reconciling the data using more or less formal procedures and a great deal of judgement on the part of the modeler[7]. Often one must simply decide which data are more reliable and force data from other sources to conform. The benchmark equilibrium data set satisfies the following four conditions[8]: (1) demand equals supply for every commodity, (2) zero profits are made in every industry (in practice, given a two-factor model, this means that all value added not allocated to labor is considered a return on capital), (3) all domestic agents satisfy their budget constrains (note that this does not necessarily mean that the government budget is balanced), and (4) the economy is in external sector balance, i.e., the sum of the current and capital account balances is 0.

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[7] The process of creating a benchmark equilibrium data set for Canada is described in detail in St-Hilaire and Whalley (1983).

[8] St-Hilaire and Whalley (1983, p. 177).

The third step in the process involves choosing functional forms for production and demand functions, specifying values of parameters which cannot be calibrated from the data, and calibrating the model to the benchmark equilibrium data set. Production functions are most often of the Cobb-Douglas or CES variety for primary factors; Leontief fixed coefficient specifications are typically used for intermediate inputs. Consumer demand functions are also usually chosen with convenience in mind. A Cobb-Douglas utility function yields the simplest demand specification, namely fixed expenditure shares; however, since this implies unitary income and own-price elasticities and zero cross-elasticities for all goods, it is considered too primitive for most applications. In this study, a Linear Expenditure System, derived from a Stone-Geary utility function, was used.

The main reason for the widespread use of these rather unsophisticated functional forms is the desire to minimize the number of parameters which must be supplied by the modeler. Thus, if a Cobb-Douglas production function is used, the share parameters can be inferred from the labor and capital shares of value added in the benchmark equilibrium data set. On the other hand, if a CES specification is adopted, the elasticity of substitution between labor and capital must be supplied to the model. With more complicated functional forms, the number of parameters which cannot be calibrated from the data grows rapidly. The lack of reliable econometric estimates of the various elasticities is a serious problem in all CGE modeling efforts. This deficiency is especially acute with respect to elasticities of substitution and export and import demand elasticities for individual countries.

This method of obtaining parameters for the model - calibration to a single data point coupled with estimates from other sources - is widely recognized as one of the main weaknesses of CGE models. In order to alleviate this problem somewhat, it has become standard practice to run CGE models with different sets of elasticities to gauge the sensitivity of the results to the parameter values. Undoubtedly, the ideal procedure would be econometric estimation of the entire system of equations. Some attempts in this direction have been made[9], but for all but the most rudimentary CGE models, calibration remains the only feasible alternative. Econometric estimation would require a time-series sequence of equilibrium data sets of prohibitive length.

Following calibration, the model is solved using the calibrated parameters to ensure that it does in fact replicate the benchmark equilibrium as a solution. This step is referred to as "replication check" in Figure 3-1. Simulations are performed by changing the values of the relevant exogenous variables (such as tax rates or world prices of goods) and computing a new static equilibrium. The effect of the exogenous changes is analyzed by comparing this solution to the benchmark equilibrium. Thus, a CGE model simulation is a comparative statics exercise applied to an actual economy.

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[9] Mansur and Whalley (1984) and Jorgenson (1984).

Since CGE models began to be widely used in the 1970s, the most frequent applications have been in the areas of tax incidence and trade policy[10]. The first CGE tax model was Shoven and Whalley (1972), while Miller and Spencer (1977) and Boadway and Treddenick (1978) provide early examples of trade models.

Until now, only a limited number of studies have analyzed EC policies using CGE models[11]. The main focus of the models which have been published is the CAP. Spencer (1985) uses a Shoven-Whalley model with nine countries and two goods to calculate the welfare consequences of each member leaving the EC separately and of various trade liberalization proposals. Using the same model, Spencer (1986) models intra-EC flows resulting from agricultural policies endogenously; he finds that CAP liberalization would have very small effects on aggregate welfare. Dicke et al. (1988) and Rosenblatt et al. (1988) both examine the impact of the CAP on Germany; although their models differ in the degree of aggregation, they are essentially similar in that both are Johansen-style models, and both depart from the standard neoclassical labor market description in assuming fixed real wages. The results are very similar: liberalizing the CAP would increase Germany's GDP by 3-4%, with large declines in agriculture more than offset by substantial increases in other sectors. Significant increases in employment would also result. These calculations indicate the agricultural support has significant negative general equilibrium repercussions on other industries. High food prices attract resources to the agricultural sector and drive up their prices, hurting other sectors and depressing trade volumes.

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[10] CGE models are also often used in analyzing development policy, reflecting the strong role of the World Bank. Among more unusual applications is their use in economic history (Thomas (1987)). Geographically, the use of CGE models seems to be concentrated in the United States (Shoven, Whalley, Robinson, and others), Britain (Spencer), Australia (the ORANI project), and Canada (Whalley, Harris).

[11] Of course, multilateral trade models such as the Michigan model of world trade (Deardorff and Stern (1986)) or OECD's WALRAS model for analyzing agricultural policies (Burniaux et al. (1987)) include EC as one of the "regions" modeled. However, here I am chiefly concerned with models which focus specifically on the EC and/or individual member countries.

Munk (1989) limits his Johansen-style model to the agricultural sector in the EC as a whole, disaggregated into 32 commodities. He simulates a decrease in EC agricultural prices to world market levels and finds small declines in crop output coupled with a large fall in meat production.

No general equilibrium analyses of the EC Commission's tax harmonization proposals have appeared to date, whether for the Community as a whole or for individual countries. The next section describes a model for Denmark which will be used for that purpose.

Specification of the Model

The model used in the analyses of Chapter 4 is a CGE model of the Shoven-Whalley type. The specification of the model follows to a large degree the model described in Dervis, de Melo and Robinson (1982, Chapter 7)[12]. In this section, the equations of the model are set out; the section to follow describes the model's implementation using a Social Accounting Matrix and the HERCULES software.

The economy is divided into three producing sectors: agriculture and food processing, manufacturing, and services. Four institutional sectors are distinguished: households, corporations, the government, and the foreign sector. There are nine consumer goods and four investment goods in the model; these goods are fixed-coefficients aggregates of the produced goods (i.e., each consumer and investment good is a linear combination of the three produced goods). Table 3-1 summarizes the produced goods and the consumption and investment categories and their acronyms, which will be used in the next chapter. In what follows, the produced goods are referenced by the index *i* (i=1,2,3); the index *j* (j=1,2,3,4) refers to investment categories, and the index *c* (c=1,...,9) refers to consumption categories.

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[12] One major difference between their model and the model used here is that Dervis, de Melo and Robinson assume flexible exchange rates and an exogenous foreign capital inflow (in other words, the current account deficit is fixed), while the model described in this section is specified with a fixed exchange rate and an endogenous current account balance. In Chapter 4, this specification is varied as part of the sensitivity analysis.

Table 3-1. Sectors and Goods in CGE Model.

I. Produced Goods:	
1. Agriculture and Food Processing	AG
2. Manufacturing	IN
3. Services	SE
II. Consumption Categories:	
1. Food	FOOD
2. Beverages and Tobacco	BT
3. Clothing and Footwear	CL
4. Gross Rent, Fuel and Power	RFP
5. Household Equipment and Operations	FURN
6. Medical Care, Personal Services	MED
7. Transport and Communication	TC
8. Recreation, Education and Entertainment	LEIS
9. Miscellaneous Goods and Services	MISC
III. Investment Categories:	
1. Machinery	MACH
2. Transportation Equipment	TRANS
3. Buildings and Other Construction	CONST
4. Other Investment	OTHER

Each sector produces value added using a Cobb-Douglas production function with constant returns to scale for the two primary factors, labor and capital, while intermediate demand is modeled with a Leontief fixed-coefficients specification. The production function is shown in Equation (3-1) where XS_i is total domestic production of good X_i, A_i is the Cobb-Douglas scale parameter, α_i is the Cobb-Douglas share parameter, and L_i and K_i are the units of labor and capital used in sector *i* (a bar over a variable denotes that the variable is fixed).

$$XS_i = A_i*\overline{K}_i^{\alpha_i}*L_i^{1-\alpha_i} \qquad i=1,2,3 \qquad (3\text{-}1)$$

Capital is sector-specific and immobile so that rates of return are not equalized across sectors. Labor, on the other hand, is fully mobile. The labor market is thus neoclassical, with full employment and wage rate equalization across sectors[13]. The first-order conditions for labor and capital are:

$$PN_i*A_i*\overline{K}_i^{\alpha_i}*(1-\alpha_i)*L_i^{-\alpha_i} = W \qquad i=1,2,3 \qquad (3\text{-}2)$$

$$PN_i*A_i*\alpha_i*\overline{K}_i^{\alpha_i-1}*L_i^{1-\alpha_i} = PK_i \qquad i=1,2,3 \qquad (3\text{-}3)$$

where PN_i is the net price for good X_i (defined in (3-21) below), W is the wage rate, and PK_i is the price of capital services in sector *i*. The labor market equilibrium conditions are then:

$$L^D = \sum_{i=1}^{3} L_i \qquad (3\text{-}4)$$

$$L^D - \overline{L}^S = 0 \qquad (3\text{-}5)$$

Equation (3-4) simply defines total demand for labor as the sum of the sectoral demands, and Equation (3-5) equates labor demand to the exogenously given labor supply. Demand for intermediate goods is given by Equation (3-6):

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[13] This specification of the labor market is known as the neoclassical closure. An alternative formulation, called the Keynesian labor market closure, is to let W be exogenous. In that case, total employment adjusts to shocks to the system. It may be appropriate when modeling situations where strong unions or some other external influence prevents wage adjustments in the market.

$$V_i = \sum_{k=1}^{3} a_{ik} * X_k \qquad i=1,2,3 \qquad (3\text{-}6)$$

where V_i is the intermediate demand for good X_i and the a_{ik} are the input-output coefficients.

The four investment goods are composed of the three produced goods in fixed proportions. Investment demand for the i'th produced good is:

$$INV_i = \sum_{j=1}^{4} i_{ij} * I_j \qquad i=1,2,3 \qquad (3\text{-}7)$$

where I_j is the quantity of the j'th investment good and the i_{ij} are the elements in the (3x4) matrix which translates the 3-dimensional vector of produced goods into the 4-dimensional vector of investment goods. Total investment in the economy is exogenous[14] and is given by:

$$\overline{TINV} = \sum_{j=1}^{4} s_j * I_j \qquad (3\text{-}8)$$

where s_j is the fixed quantity share of the j'th investment good in total investment.

---

[14] This macroeconomic closure yields, in Drud and Kendrick's (1988) terminology, an "investment-driven" model; other macroeconomic closures are also possible and will be explored in Chapter 4.

Households are assumed to maximize a Stone-Geary utility function, yielding a Linear Expenditure System (LES)[15] as the consumption demand system. Demand for the c'th consumer good is:

$$PC_c*C_c = PC_c*\gamma_c+\beta_c*(TCONS-\sum_{c=1}^{9} PC_c*\gamma_c) \qquad c=1...9 \quad (3\text{-}9)$$

where PC_c is the consumer price (defined in (3-22) below) and C_c is the quantity of the c'th consumption good. γ_c is the committed quantity in LES, and β_c is the marginal propensity to consume good *c* out of supernumerary income[16]. Total consumption expenditure is:

$$TCONS = (1-\overline{S_{HH}})*Y_{HH} \qquad (3\text{-}10)$$

where S_{HH} is the saving rate of households (assumed fixed) and Y_{HH} is the after-tax household income. Finally, (3-11) shows the translation of the consumption goods into produced goods, analogously to investment:

$$CONS_i = \sum_{c=1}^{9} c_{ic}*C_c \qquad i=1,2,3 \qquad (3\text{-}11)$$

---

[15] The LES is described in all standard works on consumption demand; see, for example, Deaton and Muellbauer (1980).

[16] The idea behind the LES is that consumers have a fixed bundle of goods, $[\gamma_c]$, which is necessary to achieve a minimum level of utility. Any income left over after purchasing this bundle is spent according to the marginal shares $[\beta_c]$. The γ_c's may be negative, in which case the goods in question have a price elasticity higher than 1. The β_c's lie between 0 and 1, and their sum equals 1.

$CONS_i$ is the consumption demand for the i'th industry's output while the c_{ic} are the coefficients in the (3x9) consumption composition matrix.

Government consumption is assumed fixed in quantity terms, i.e., the government has a certain activity plan which will be carried out regardless of cost. Total demand for domestically produced goods intended for domestic uses can now be written as:

$$D_i = d_i*(INV_i+CONS_i+V_i+\overline{G_i}) \qquad i=1,2,3 \qquad (3\text{-}12)$$

where d_i is the domestic use ratio, determined from the import demand function, (3-18). Total demand for domestic goods is then the sum of domestic use and export demand:

$$XD_i = D_i+E_i \qquad i=1,2,3 \qquad (3\text{-}13)$$

Equation (3-14) defines equilibrium in the product market:

$$XD_i-XS_i = 0 \qquad i=1,2,3 \qquad (3\text{-}14)$$

The portions of the model outlined so far conform closely to the traditional Walrasian paradigm, with the exception of sector-specific capital stocks. However, when modeling international transactions, it is almost always necessary to depart somewhat from the standard Heckscher-Ohlin-Samuelson (henceforth H-O-S) theory.

The problems in applying H-O-S in empirical models stem from the use of constant returns to scale in production coupled with the small country assumption on the export and import side. The small country assumption says that the country cannot influence world prices of the commodities it imports or exports by its actions - clearly, a reasonable assumption for a country like Denmark, especially considering the level of aggregation in the model. However, as shown in Dervis, de Melo and Robinson (1982, Ch. 6), the small country assumption in its pure form in a model with more traded goods than factors of production and constant returns to scale will result in complete specialization in M goods, where M is the number of factors. The assumption of sector-specific capital stocks prevents complete specialization from happening - in effect, it increases the number of factors. However, the model will still show excessive responsiveness to changes in terms of trade, such as exogenous changes in world prices[17]. In addition, the assumption of homogenous products in H-O-S theory is empirically problematic because it does not allow for two-way trade[18].

The way to overcome these difficulties is to abandon the assumption of perfect substitutability between domestic and imported goods. Once product differentiation is introduced, the small country assumption may no longer be appropriate on the export side. With differentiated products, even a small country may face downward-sloping demand curves for its products. Accordingly, following the approach in Dervis, de Melo and Robinson (1982, p. 226), the export demands are assumed to have the following form:

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[17] For an example of this phenomenon, see Clarete and Roumasset (1987) who employ a model with homogeneous products and sector-specific factors to analyze effects of tariff changes in the Philippines.

[18] Two-way trade (sometimes called cross-hauling) refers to the simultaneous import and export of the same good. It has been observed in commodities at extremely disaggregated levels; to account for it without resorting to product differentiation would require a model with thousands of commodities.

$$E_i = E_0 * \left(\frac{\overline{PW}_i}{PWE_i} \right)^{\epsilon_i} \qquad i=1,2,3 \qquad (3\text{-}15)$$

where E_i is the export demand for sector i's output, PW_i is the exogenous world price of good i, measured in foreign exchange, PWE_i is the supply price of exports of good i, also in terms of foreign currency, E_0 is a constant showing the level of exports at the point where $PWE_i = PW_i$, and ϵ_i is the elasticity of export demand. Thus, the small country assumption has been retained in the sense that Denmark still cannot influence the world price PW_i; however, Denmark's market share in its export markets depends on how competitive Danish exporters are, measured by the ratio of their supply price to the world price. The supply price of exports depends on Danish domestic prices and trade policy:

$$PWE_i = \frac{PD_i}{(1+te_i) * \overline{ER}} \qquad i=1,2,3 \qquad (3\text{-}16)$$

where PD_i is the domestic price of good *i*, te_i is the rate of export subsidy, and ER is the exchange rate (measured as the domestic price of foreign currency, e.g. DKR/\$). It is assumed that Danish producers are indifferent between exporting and selling in the domestic market, so export supply is defined implicitly and residually as the difference between production and domestic sales[19].

On the import side, following the suggestion of Armington (1969), there is imperfect substitution between imported and domestic goods. In the model, I thus assume that in each sector, foreign and Danish goods are combined to form a composite commodity, using a CES aggregation function, shown in (3-17).

$$Q_i = B_i * [\delta_i * M_i^{-\rho_i} + (1-\delta_i) * D_i^{-\rho_i}]^{-\frac{1}{\rho_i}} \qquad i=1,2,3 \qquad (3\text{-}17)$$

where B_i, δ_i, and ρ_i are parameters. Demand for imports of good *i* is then given by (3-18):

$$M_i = \left(\frac{\delta_i}{1-\delta_i}\right)^{\sigma_i} * \left(\frac{PD_i}{PM_i}\right)^{\sigma_i} * D_i \qquad i=1,2,3 \qquad (3\text{-}18)$$

where $\sigma_i=(1/1+\rho_i)$ is the elasticity of substitution between imported and domestic goods. The domestic use ratio, d_i, i.e., the ratio of imports to total domestic use, is implicitly defined by (3-18)[20]. This specification has three interesting special cases: for $\sigma_i=0$, there is no substitution between imports and domestic goods - this is the case of "non-competitive imports" sometimes used in models of developing countries to describe imports of, say, essential investment goods not manufactured domestically; for $\sigma_i=1$, (3-17) reduces to a Cobb-Douglas specification, and the value share of imports remains constant; and $\sigma_i \rightarrow \infty$ represents the case of perfect substitutability between imports and domestic goods.

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[19] Some authors advocate the use of an explicit export supply function. Dervis, de Melo and Robinson (1982) use a logistic supply curve, while de Melo and Robinson (1989) use a formulation where there is product differentiation in production and a Constant Elasticity of Transformation (CET) specification for domestic sales and exports.

[20] See Dervis, de Melo and Robinson (1982, p. 223).

The import price measured in DKR, PM_i, is a reflection of exogenous world prices and trade policy:

$$PM_i = \overline{PW_i} * (1+tm_i) * \overline{ER} \qquad i=1,2,3 \qquad (3\text{-}19)$$

where tm_i is the tariff rate on imports of good *i*. Given the import demand function, the price of the composite good will be:

$$P_i = [\delta_i^{\sigma_i} * PM_i^{1-\sigma_i} + (1-\delta_i)^{\sigma_i} * PD_i^{1-\sigma_i}]^{\frac{1}{1-\sigma_i}} \qquad i=1,2,3 \qquad (3\text{-}20)$$

It should be noted that I have implicitly assumed that the elasticity of substitution between imported and domestic goods of a given category is the same for all uses. Purchasers of intermediate products, consumer goods, and investment goods, are confronted with this composite price, and the concepts of net price and consumption and investment goods prices can now be defined. The net price in producing sector *i* is defined as:

$$PN_i = PD_i * (1-tp_i) - \sum_{k=1}^{3} P_k * a_{ki} \qquad i=1,2,3 \qquad (3\text{-}21)$$

where tp_i is the indirect tax rate on production. The consumer price PC_c is defined in (3-22), and the price of the j'th investment good in (3-23).

$$PC_c = \left(\sum_{i=1}^{3} c_{ic}*P_i\right)*(1+tc_c)*(1+vc_c) \qquad c=1\ldots9 \qquad (3\text{-}22)$$

$$PI_j = \left(\sum_{i=1}^{3} i_{ij}*P_i\right)*(1+ti_j) \qquad j=1\ldots4 \qquad (3\text{-}23)$$

where tc_c and vc_c are the excise tax and VAT rates on the c'th consumption good, and ti_j is the excise tax rate on the j'th investment good.

The following set of equations defines the income flows in the model. Equations (3-24) and (3-25) show the functional income distribution:

$$R_L = \sum_{i=1}^{3} W*L_i \qquad (3\text{-}24)$$

$$R_K = \sum_{i=1}^{3} (PN_i*X_i-W*L_i) \qquad (3\text{-}25)$$

where R_L is labor income and R_K is capital income. Household income is defined in (3-26):

$$Y_{HH} = (R_L+a_{HH}*R_K+\overline{GTR_{HH}}+\overline{FACABR})*(1-t_{HH}) \qquad (3\text{-}26)$$

where a_{HH} is the share of capital income accruing to households, GTR_{HH} are government transfer payments to households, FACABR are factor payments from abroad, and t_{HH} is the personal income tax rate.

Equation (3-27) defines corporate income; a_{CO} is the share of capital income accruing to corporations, and t_{CO} is the corporate tax rate.

$$Y_{CO} = a_{CO} * R_K * (1 - t_{CO}) \tag{3-27}$$

Government income is the sum of tax receipts from personal income taxes, corporate taxes, the government's share of corporate income (reflecting state-owned enterprises), import tariffs less export subsidies, and indirect taxes on production, consumption, and investment, as shown in (3-28).

$$\begin{aligned} Y_{GOV} = {} & Y_{HH} * \frac{t_{HH}}{1 - t_{HH}} + Y_{CO} * \frac{t_{CO}}{1 - t_{CO}} + g_{CO} * Y_{CO} \\ & + \sum_{i=1}^{3} tm_i * \overline{PW}_i * \overline{ER} * M_i - \sum_{i=1}^{3} te_i * PWE_i * \overline{ER} * E_i \\ & + \sum_{i=1}^{3} tp_i * PD_i * X_i + \sum_{c=1}^{9} t_c * PC_c * C_c \\ & + \sum_{j=1}^{4} ti_j * PI_j * I_j \end{aligned} \tag{3-28}$$

where g_{CO} is the government's share of corporate income and tc_c is the combined excise and VAT rate on consumption, defined such that $(1+t_c)=(1+tc_c)*(1+vc_c)$. Finally, (3-29) shows the income of the foreign sector (ROW) as the sum of its share of capital income, government transfers, and imports:

$$Y_{ROW} = a_{ROW}*R_K+\overline{GTR_{ROW}}+\sum_{i=1}^{3} \frac{PM_i}{1+tm_i}*M_i \tag{3-29}$$

where a_{ROW} is the proportion of capital income going abroad and GTR_{ROW} are net government transfers abroad[21].

The last group of equations defines the savings rates of the four institutions and imposes a balance of payments constraint. The savings of households and corporations (i.e., retained earnings) are determined by applying fixed saving rates to their incomes, while the savings of the foreign sector and the government are determined residually. For households and corporations, we have:

$$SAV_{HH} = \overline{S_{HH}}*Y_H \tag{3-30}$$

$$SAV_{CO} = \overline{S_{CO}}*Y_{CO} \tag{3-31}$$

Government savings are defined as government income less government expenditures on transfers to households, government consumption, and transfers to foreigners:

$$SAV_{GOV} = Y_{GOV}-\overline{GTR_{HH}}-\sum_{i=1}^{3} P_i*\overline{G_i} \tag{3-32}$$

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[21] This item includes various foreign aid payments and contributions to international organizations including the EC, net of payments received, such as the EAGGF subsidies to Danish agriculture.

Foreign savings, F, are the difference between investment and domestic savings:

$$F = \sum_{j=1}^{4} P_j * I_j - SAV_{HH} - SAV_{CO} - SAV_{GOV} \qquad (3\text{-}33)$$

Total savings in the economy are given by:

$$TSAV = SAV_{HH} + SAV_{CO} + SAV_{GOV} + F \qquad (3\text{-}34)$$

Equation (3-35) is the economy's balance of payments constraint:

$$\sum_{i=1}^{3} \overline{PW}_i * M_i - \sum_{i=1}^{3} PWE_i * E_i - \overline{FACABR} + a_{ROW} * R_K + \overline{GTR_{ROW}} - F = 0 \qquad (3\text{-}35)$$

Finally, in equation (3-36) the exchange rate is defined as the numeraire:

$$ER = 1 \qquad (3\text{-}36)$$

Equations (3-1) through (3-36) together define the model. Table 3-2 contains a listing and a count of the endogenous variables. There are 87 equations and 86 endogenous variables. However, due to Walras' Law, only 86 of the equations are independent, so the system is balanced.

As noted above, this model is investment-driven, because total investment (and government consumption) are exogenous, while all categories of saving are endogenous. Alternative macroeconomic closures are possible, however[22]. For example, foreign and government savings could be made exogenous (perhaps reflecting macroeconomic policy goals or perceived limits to foreign borrowing), and the exchange rate and total investment would then be endogenous. Such a model is said to be savings-driven.

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[22] For a general discussion of macroeconomic closure in CGE models, see Robinson and Roland-Holst (1988).

Table 3-2. Endogenous Variables in CGE Model for Denmark.

Variable		Number
PM_i	Import prices	3
PWE_i	Export prices	3
P_i	Composite goods prices	3
PN_i	Net prices	3
PD_i	Domestic prices	3
PC_c	Consumption goods prices	9
PI_j	Investment goods prices	4
XS_i	Sectoral production	3
XD_i	Sectoral demand	3
L_i	Sectoral employment	3
W	Wage rate	1
PK_i	Sectoral capital prices	3
E_i	Export demand	3
M_i	Import demand	3
F	Foreign saving	1
SAV_{HH}	Household saving	1
SAV_{GOV}	Government saving	1
SAV_{CO}	Corporate saving	1
TSAV	Total saving	1
R_L	Labor income	1
R_K	Capital income	1
Y_{HH}	Household income	1
Y_{CO}	Corporate income	1
Y_{GOV}	Government income	1
Y_{ROW}	Foreign sector income	1
INV_i	Investment demand for good i	3
$CONS_i$	Consumption demand for good i	3
C_c	Consumption demand	9
TCONS	Total consumption	1
V_i	Intermediate demand	3
D_i	Total domestic use	3
d_i	Domestic use ratio	3
Q_i	Composite goods	3
TOTAL		86

Model Implementation

The implementation of the model described in the previous section is based on a Social Accounting Matrix (SAM) for 1984[23]. The HERCULES software package described in Drud and Kendrick (1988) was used to calibrate and solve the model.

A SAM is a concise way to describe the structure of an economy. As applied general equilibrium modeling began to be widely used, the many deficiencies in existing national accounts data alluded to in the first section of this chapter became apparent. Since the development of national accounting was mainly motivated by the Keynesian revolution in macroeconomics and the need for data bases for construction of macroeconometric models, standard national accounts data are not always suitable for CGE models. Thus, the modeler must usually construct a data set which is consistent at the microeconomic level. A SAM is a valuable aid in this effort because during its construction inconsistencies in the data are clearly exposed and can be dealt with.

The full base SAM used for the implementation of the model is shown in Appendix A. Table 3-3 below shows a condensed version of the SAM.

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[23] For an introduction to Social Accounting Matrices, see King (1981). The use of SAMs in CGE models is discussed in Dervis, de Melo and Robinson (1982), Pyatt (1988) and Kendrick (1990), among others.

Table 3-3. Social Accounting Matrix for Denmark, 1984 (mill. DKR).

		1	2	3	4	5	6	7	8	9	10	11
1	LABOR											306096
2	CAPITAL											175582
3	HH-INCOME	306096	101109			114172						
4	HH-CONSUMPTION			308103								
5	GOV-INCOME							164698	7481		83611	
6	GOV-CONSUMPTION					146176						
7	DIRECT TAXES			150474					14224			
8	COMPANIES		48116									
9	SAV-INV			76974		-17941			26411			
10	INDIRECT TAXES											
11	VALUE ADDED											
12	PRODUCTION											
13	DOMESTIC GOODS											
14	IMPORTED GOODS											
15	COMPOSITE GOODS						146176					
16	CONSUMPTION GOODS				308103							
17	INVESTMENT GOODS									103937		
18	EXPORTS											
19	FACTORS ABROAD											
20	REST-OF-WORLD		26357			13383						
	TOTAL	306096	175582	535551	308103	255790	146176	164698	48116	103937	83611	481678

Table 3-3 -- continued.

		12	13	14	15	16	17	18	19	20	TOTAL
1	LABOR										306096
2	CAPITAL										175582
3	HH-INCOME								14174		535551
4	HH-CONSUMPTION										308103
5	GOV-INCOME										255790
6	GOV-CONSUMPTION										146176
7	DIRECT TAXES										164698
8	COMPANIES										48116
9	SAV-INV									18493	103937
10	INDIRECT TAXES	14156		1694		63532	9263	-5034			83611
11	VALUE ADDED	481678									481678
12	PRODUCTION		734430					212518			946948
13	DOMESTIC GOODS				734430						734430
14	IMPORTED GOODS				202105						202105
15	COMPOSITE GOODS	451114				244571	94674				936535
16	CONSUMPTION GOODS										308103
17	INVESTMENT GOODS										103937
18	EXPORTS									207484	207484
19	FACTORS ABROAD									14174	14174
20	REST-OF-WORLD			200411							240151
	TOTAL	946948	734430	202105	936535	308103	103937	207484	14174	240151	

In Table 3-3, the three producing sectors have been aggregated into one, PRODUCTION; the four investment goods and the nine consumption goods have also been aggregated, and excise taxes and VAT have been combined. The key concept in the SAM is the "institution". An institution can be a producing or consuming sector, a group of commodities, or the rest of the world. The SAM is essentially an augmented input-output table, with one row and one column corresponding to each institution. Per convention, the columns in the SAM make payments to the rows, and each account balances, i.e., the sum of payments made by each institution is equal to the sum of payments received by it. The first two institutions, labor and capital, receive the value added from the producing sectors and distribute it to their owners: households, companies, and the rest of the world. The household income account [3] receives factor payments from domestic capital and labor and from abroad, as well as government transfer payments. The receipts of the account are then distributed among consumption, savings, and direct taxes. The household consumption account [4] receives the total private consumption expenditure from the household income account and allocates it among the 9 consumption goods. The government income account [5] collects tax receipts from direct and indirect taxes, as well as the government's share of dividends paid by companies in which the government has partial ownership. In turn, the government's receipts are used for transfer payments to households, government consumption, government saving, and transfers to other countries. The government consumption account [6] allocates government consumption to composite goods. The direct tax account [7] receives income tax payments from households and companies and pays the total to the government income account. Companies [8] receive a portion of the total return on capital and distribute it among the government income, the direct tax, and the savings-investment accounts. The savings-investment account [9] collects savings from households, the government (budget surplus or deficit), companies (retained earnings), and the rest of the world (current account deficit or surplus), and uses those funds to purchase investment goods. The indirect tax account [10] collects import tariffs, export taxes (which in this case are negative, i.e., they are export subsidies), excise taxes on production, investment and consumption, and pays the total to the government income account. The value added account [11] collects value added from the production account and pays it to the factors of production. The production account [12] receives gross output value from the domestic goods account and from exports and allocates it among value added and the composite goods (i.e.,intermediate products). Thus, the cell defined by row 15 and column 12 constitutes the collapsed input-output table. The domestic goods account [13] receives the value of domestic production from the composite goods account and transfers it to the production account. The imported goods account [14] receives payments for imports including tariffs from the composite goods account, pays tariffs to the indirect tax account, and transfers the remainder to the rest of the world. The composite goods account [15] receives payments from all domestic sources of demand: government consumption, investment goods, consumption goods, and intermediate goods. The proceeds are allocated to domestic and imported goods. The consumption goods account [16] receives the value of household consumption from the household income account, pays indirect taxes, and transfers the remainder to the composite goods account. The investment goods account [17] does the same for investment, allocating the funds received from the savings-investment account to indirect taxes and investment goods. The export account [18] receives payment for exports from abroad and government export subsidies (the latter shown as a negative indirect tax payment) and pays the sum to the production accounts. The factors-abroad account [19] collects factor payments from abroad and pays them to households. The rest-of-world account receives payments from capital (corresponding to foreign ownership of Danish assets), the government (foreign aid and debt service), and imports. In turn, the account makes payments to the export accounts, the factors-abroad account (corresponding to Danish ownership of foreign factors of production), and to the savings-investment account (the current account deficit).

In HERCULES, the base SAM is used to define the model and calibrate most of the model parameters. The SAM is transformed into a model once functional forms for the payments in the table are specified and parameter values which cannot be calibrated from the data are furnished by the modeler. The HERCULES implementation of the model is shown in Appendix B. HERCULES has been described by one of its creators as a "modeling system with knowledge about economics". It uses the General Algebraic Modeling System (GAMS) developed at the World Bank for calculations and report-writing[24]. From the modeler's standpoint, HERCULES is extremely easy to use, because there is no need to write down any equations. The economics of the SAM are specified using acronyms such as CD (for Cobb-Douglas) or CES for each cell in the SAM; the modeler must also furnish values for parameters which cannot be calibrated from the data (in this case, the trade elasticities of substitution, the LES parameters, and the export demand elasticities). Once this is done, HERCULES generates the equations of the model, performs error checking, calibrates the model parameters, and performs the experiments requested.

The numbers in the SAM are values, i.e., they are mostly payments of the form price*quantity[25]. Calibration in the SAM is made possible by assuming that in the base case, all prices are unity. As mentioned earlier in this chapter, this method was pioneered by Harberger (1962). The payments in the base SAM can now be interpreted as quantities, where appropriate, and the model can be calibrated.

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[24] GAMS is described in Kendrick and Meeraus (1987).

[25] Of course, certain payments, such as government transfers or the current account deficit, do not have associated prices or quantities.

The majority of the parameters in the model equations in the previous section can be inferred directly from the base SAM in Appendix A. For example, the parameter α_1 in Equation (3-1) - the Cobb-Douglas share parameter in agriculture - is the share of capital in agricultural value added, or 34695/52445=0.662. The efficiency parameter A_1 is then given by:

$$A_1 = 52445/[34695^{0.662}*17750^{0.338}] = 1.897$$

Table 3-4 shows the production function parameters for the 3 producing sectors.

Table 3-4. Cobb-Douglas Production Function Parameters.

	A_i	α_i
AG	1.897	0.662
IN	1.876	0.323
SE	1.886	0.330

Thus, the agricultural sector is relatively capital-intensive, while the industrial and service sectors are labor-intensive.

The input-output coefficients a_{ik}, showing the intermediate input requirement per unit of output in sector *i*, are also computed directly from the base SAM. They are shown, along with the share of value added in gross output, in Table 3-5.

Table 3-5. Input-output Coefficients.

	AG	IN	SE
AG	0.464	0.017	0.012
IN	0.109	0.461	0.118
SE	0.102	0.134	0.245
Value added	0.337	0.386	0.598

NOTE: The columns do not add up to 1 due to the presence of indirect taxes on production (see Table 3-7).

As one might expect, the services sector has the highest value added ratio, while agriculture has the lowest. The relatively small difference between agriculture and industry lies in the definition of agriculture to include food processing; thus, the value added to farm products during food processing is here assigned to agriculture.

Table 3-6 summarizes the factor income shares, the savings rates, and the direct tax rates for the various institutions.

Table 3-6. Factor Income Shares, Savings Rates, and Direct Tax Rates.

	Factor Income Share:		Savings Rate	Direct Tax Rate
	L	K		
Households	1.000	0.576	0.200	0.281
Companies	-	0.274	0.779	0.296
Rest-of-world	-	0.150	-	-

NOTE: Savings rates are calculated based on after-tax income.

The indirect taxes in the model consist mainly of VAT and excise taxes, levied mainly on consumption[26]. Indirect tax rates are shown in Table 3-7.

Table 3-7. Indirect Tax Rates (%).

	Excise tax	VAT	Combined
Consumption:			
FOOD	1.0	20.5	21.7
BT	120.9	19.5	164.0
CL	0.0	20.5	20.5
RFP	2.8	4.5	7.4
FURN	1.8	18.8	20.9
MED	0.4	9.9	10.3
TC	35.8	12.8	53.2
LEIS	1.7	14.1	16.0
MISC	3.4	17.6	21.6
Investment:			
MACH	0.4	2.6	3.0
TRANS	11.1	3.2	14.3
CONST	2.4	13.0	15.4
OTHER	0.0	0.0	0.0
Production:			
AG	-1.1	0.0	-1.1
IN	0.2	0.1	0.3
SE	0.7	2.0	2.7
Imports:			
IN	1.1	0.0	1.1
Exports:			
AG	-8.1	0.0	-8.1

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[26] Small amounts of taxes are also levied on production, investment, and imports. Export taxes are all negative, i.e., they are in fact subsidies. There are also net subsidies for agricultural production. Small amounts of production subsidies are also granted to the other sectors; however, net indirect taxes are positive in those cases.

The VAT on consumption is applied to the amount including excise taxes, so that the combined indirect tax rate is very high for some consumption categories, such as beverages and tobacco, and transport and communication (the latter reflecting the high excise tax rates on gasoline and automobiles).

The final three groups of parameters cannot be calibrated from the SAM: the LES parameters, and trade substitution elasticities, and the export demand elasticities.

The LES parameters γ_c and $ß_c$ in Equation (3-9) were chosen so as to yield reasonable own-price and income elasticities of demand, based on literature estimates, particularly Danish Economic Council (1980). In practice, this was done by choosing appropriate γ_c's; given those, the $ß_c$'s could be calculated by HERCULES[27]. Table 3-8 shows the LES parameters and the income and own-price elasticities for the 9 consumption categories. The elasticities appear intuitively reasonable; it is worth noting that the high income elasticity of medical care and personal services reflects the fact that basic medical care is not included in this category, as that is provided publicly in Denmark.

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[27] The income elasticity in the LES is given by $e_Y = ß_c/w_c$, where w_c is the budget share of the c'th consumption good. Thus, given the desired income elasticities, preliminary $ß_c$'s can be computed as $ß_c = e_Y*w_c$. The γ_c's can then be calculated by solving the 9-equation system $\gamma_c = Y*[w_c-ß_c*(Y-\Sigma\gamma_c)/Y]$ (c=1,...,9). Note that this formulation assumes P_c=1 for all c, as is the case in the base SAM. For further details, see Deaton and Muellbauer (1980, Ch. 3).

Table 3-8. LES Parameters and Elasticities.

	γ_c	β_c	e_Y	e_P
FOOD	43478	0.036	0.21	-0.20
BT	10645	0.053	0.70	-0.57
CL	3208	0.061	1.05	-0.83
RFP	26260	0.218	0.85	-0.74
FURN	-3081	0.099	1.47	-1.13
MED	-2037	0.032	1.77	-1.37
TC	-9819	0.256	1.52	-1.14
LEIS	-349	0.124	1.29	-1.01
MISC	-1006	0.122	1.33	-1.03

For the two parameters related to foreign trade, ϵ_i in Equation (3-15) and σ_i in Equation (3-18), values deemed reasonable were chosen in a somewhat *ad hoc* manner. There have been virtually no Danish studies upon which the estimation of these elasticities could be based. Knudsen (1989) estimated the export demand elasticity for Danish manufacturing to be 2.5. Since agricultural products may be presumed to be more homogeneous, and services less homogeneous than industrial products, I have chosen ϵ to be 5.0 for agriculture and 1.0 for services. Based on similar homogeneity considerations, the trade substitution elasticity σ was set at 3.0 for agriculture, 1.0 for industry, and 0.5 for services[28]. This procedure for selecting the trade parameters is obviously less than satisfactory, but in the absence of econometric estimates it remains the only feasible method. To gauge the sensitivity of the results to the trade elasticities, a "high-elasticity" case was also specified, where the export demand elasticities are set to infinity. A "low-elasticity" case was not specified, since I did not consider it relevant for a small country like Denmark. In addition, the experiments were also run under different macroeconomic and labor market closures, as will be seen in Chapter 4.

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[28] Equation (3-18) also contains the parameter δ_i. Once the substitution elasticity is specified, δ_i is easily calculated in the base SAM (remembering that $PD_i=PM_i=1$) as $1/[(M_i/D_i)^{-1/\sigma}+1]$.

As a quick reference for the simulation results in Chapter 4, Table 3-9 provides a brief description of the structure of the economy in the base SAM.

Table 3-9. The Structure of the Base SAM Economy.

	Gross Output	Gross Output Share	Export Share	Value Added Ratio	K/L Ratio	Export Ratio	Import Ratio
AG	155829	16%	28%	34%	1.95	37%	22%
IN	207681	22%	51%	39%	0.48	51%	59%
SE	583438	62%	21%	60%	0.49	8%	4%

NOTES:
Gross output in mill. DKR.
Gross output share = share of sector in total gross output.
Export share = share of sector in total exports.
Value added ratio = share of value added in total output.
K/L ratio = capital/labor ratio.
Export ratio = percentage of sector's output which is exported.
Import ratio = percentage of composite commodity which is imported.

CHAPTER 4
SIMULATIONS OF TAX AND AGRICULTURE POLICY CHANGES

This chapter reports the results of model experiments designed to evaluate (1) the effects of the tax changes proposed by the EC Commission, and (2) the impact of abolishing the Common Agricultural Policy. Each set of simulations was carried out using the export demand elasticities shown in Chapter 3[1], labelled "Standard Elasticities", as well as with infinitely elastic export demand, corresponding to the extreme small country assumption, and labelled "High Elasticities" in the tables to follow.

Besides analyzing the sensitivity of the results to export demand elasticities, I also explore the impact of varying the savings-investment and labor market closures. With respect to macroeconomic closure, the standard model outlined in Chapter 3 is investment-driven, because investment and government consumption are exogenous while foreign savings and government savings are endogenous. An alternative formulation has investment and government consumption endogenous and foreign and government savings exogenous. In some ways, such a savings-driven model more closely mirrors the situation of

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[1] That is, 5.0 for agriculture, 2.5 for industry, and 1.0 for services.

Danish policy-makers who often operate under constraints on the politically acceptable sizes of the balance of payments and government budget deficits.

The standard model has a neoclassical labor market, since full employment is assumed and the wage is endogenous. In a Keynesian labor market closure, the real wage is exogenous, and total employment is endogenous. This closure is implemented by making W and the price of household consumption (i.e., the consumer price index) exogenous. The price of consumption rather than the exchange rate serves as numeraire in this version of the model. One of the strengths of SAM-based models and the HERCULES software is precisely the ease with which the modeler can vary the closure, a fundamental characteristic of any model.

In the first section of this chapter, the tax harmonization proposals are analyzed using the investment-driven model with neoclassical labor market closure. In the following section, CAP reform is simulated with the standard model. In the final section, the policy experiments are repeated under varying closure rules.

Simulation of Tax Harmonization Proposals

Two tax experiments were conducted to approximate the EC Commission's tax harmonization proposals, as outlined in Chapter 2. The VAT on food and clothing and footwear is reduced by 60%, the VAT on all other goods is reduced by 10%, excise taxes on beverages and tobacco are reduced by 75% and those on transport and communication by 80%, while all other excise taxes are abolished. These reductions correspond to an approximation of Danish indirect taxes to the upper limit of the ranges proposed by the Commission.

In Experiment 1, the tax cuts are enacted without any compensating changes in other taxes or government spending. In Experiment 2, government consumption and government transfer payments to households are reduced by 10% as a compensating measure[2].

Table 4-1 summarizes the impacts of the tax changes on key macroeconomic balances. The first two columns show the results with the standard export demand elasticities (5.0, 2.5, and 1.0 for agriculture, industry, and services, respectively), while the third and fourth column show the results obtained with infinitely elastic export demands.

Table 4-1. Experiment Results for Macroeconomic Balances.

Elasticities:	STANDARD			HIGH	
	Base	Exp. 1	Exp. 2	Exp. 1	Exp. 2
	% OF GDP				
Trade	1.3	-1.7	0.5	-3.3	0.5
Current Account	-3.3	-6.4	-4.3	-8.0	-4.2
Gov't Budget	-3.2	-6.7	-4.0	-8.1	-4.0

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[2] See footnote 8 in Chapter 2 for a rationalization of the 10% figure.

Table 4-2 shows the effects of the tax changes on consumption, production, imports and exports, GDP, and total absorption. In this, as in all other simulations in this study, total domestic absorption, i.e., the sum of household consumption, investment, and government consumption, will be used as the measure of aggregate welfare.

Table 4-2. Experiment Results - Quantities.

Elasticities:	STANDARD		HIGH	
	EXP. 1	EXP. 2	EXP. 1	EXP. 2
	------- % change from base -------			
Household consumption:	12.5	9.4	11.8	9.4
FOOD	3.2	1.9	2.5	2.0
BT	45.4	39.5	42.5	39.9
CL	15.2	9.5	12.2	9.7
RFP	2.0	0.7	2.4	0.6
FURN	8.4	2.2	5.6	2.4
MED	6.1	1.9	5.6	1.9
TC	39.2	34.2	38.3	34.2
LEIS	5.8	1.7	4.5	1.7
MISC	4.3	2.2	4.9	2.1
Government consumption	0.0	-10.0	0.0	-10.0
Investment	0.0	0.0	0.0	0.0
Total domestic absorption	6.9	2.6	6.5	2.6
Real GDP	2.8	2.3	2.6	2.3
Production-AG	-4.5	0.7	-0.1	-0.1
Production-IN	-6.6	1.1	-0.5	-0.5
Production-SE	2.1	-0.3	0.1	0.1
Exports-AG	-9.4	-1.8	-4.0	-3.6
Exports-IN	-10.6	0.2	-2.9	-2.4
Exports-SE	-8.4	0.7	-33.8	7.0
Imports-AG	4.9	3.5	2.4	2.2
Imports-IN	2.0	1.9	2.0	1.5
Imports-SE	7.6	-0.8	3.0	-0.4

Changes in various prices resulting from the tax cuts are shown in Table 4-3.

Table 4-3. Experiment Results - Prices.

Elasticities:	STANDARD		HIGH	
	EXP. 1	EXP. 2	EXP. 1	EXP. 2
	------- % change from base -------			
Household consumption	-4.6	-10.7	-10.4	-10.4
FOOD	-7.0	-10.2	-10.2	-10.2
BT	-39.5	-42.1	-42.0	-42.0
CL	-6.3	-10.4	-10.2	-10.2
RFP	7.8	-1.1	-0.4	-0.4
FURN	3.5	-1.9	-1.6	-1.6
MED	6.3	-1.4	-0.9	-0.9
TC	-16.5	-22.4	-22.0	-22.0
LEIS	5.1	-1.7	-1.2	-1.2
MISC	6.6	-2.1	-1.5	-1.5
Domestic AG	2.0	0.4	0.0	0.0
Domestic IN	4.6	-0.1	0.0	0.0
Domestic SE	9.1	-0.7	0.0	0.0
Imported AG	0.0	0.0	0.0	0.0
Imported IN	0.0	0.0	0.0	0.0
Imported SE	0.0	0.0	0.0	0.0
Composite AG	1.5	0.3	0.0	0.0
Composite IN	1.8	0.0	0.0	0.0
Composite SE	8.8	-0.7	0.0	0.0
Exported AG	2.0	0.4	0.0	0.0
Exported IN	4.6	-0.1	0.0	0.0
Exported SE	9.1	-0.7	0.0	0.0
Labor	10.1	-0.4	0.3	0.3
Capital-AG	-3.8	1.6	-0.1	-0.1
Capital-IN	-0.4	1.2	-0.5	-0.5
Capital-SE	13.6	-0.9	0.5	0.5

Not surprisingly, consumer prices fall considerably due to the tax cuts. This is especially true for the commodities which are most heavily taxed in the base case and hence enjoy the greatest tax reductions. From Table 3-7, one sees that this is especially true for beverages and tobacco and transport and communication, which are currently subjected to very high excise tax rates. Food and clothing also become considerably cheaper due to the lowering of VAT on those products. These consumer price cuts, in turn, lead to higher consumption of all commodities, especially beverages and tobacco, clothing, and transport and communication. These results hold broadly in both experiments and also for both sets of elasticities.

The increased demand for consumer goods translates into increased demand for producer goods through the consumption composition matrix[3]. In Experiment 1, this increased demand is particularly directed at the services sector. Consequently, with standard elasticities, the price of domestic service goods rises by 9.6% over the base case. The relative price of services increases (since the price of domestic agricultural goods only rises by 2.0%, and that of domestic industrial goods by 4.6% over the base). This exerts a resource pull into the services sector; however, since sectoral capital stocks are fixed, capital prices bear the brunt of the adjustments. The price of capital in services increases by 13.6%, while capital prices in agriculture and services decline. The wage rate increases by 10% - a relatively strong effect, due to the fact that services are labor-intensive. Also, since domestic goods are now relatively more expensive than imported goods (whose price does not change, given the small country assumption and the fixed exchange rate), much of the increased demand is met through a decrease in exports and an increase in imports[4]. Finally, note that for some consumer goods for which the tax cut is not great (because they were lightly taxed to begin with) and which contain a large and now much more expensive services component, consumer prices actually rise as a consequence of the tax cuts. This is true of RFP (92% services), MED (77% services), LEIS (65% services), and MISC (92% services).

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[3] The consumption and investment composition matrices are shown in Appendix C.

With infinitely elastic export demands, the economy behaves very differently. Export prices are now fixed, and since producers are indifferent between exports and domestic sales, domestic prices must remain fixed too[5]. The adjustment takes place entirely on the quantity side. Production is virtually unchanged, while imports increase by 2-3%. However, exports of services fall drastically, as output is shifted from exports to domestic sales. Factor prices now change very little, reflecting their basic dependence on the exogenously given world prices.

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[4] Indeed, production in agriculture and industry actually declines.

[5] Strictly speaking, producers are not indifferent between exports and domestic sales, since export supply is defined residually, after domestic demand has been met. Thus, if the export and domestic prices are equal, producers prefer to sell on the domestic market; however, if the export price is higher, they will shift output to the export market until the home price has risen sufficiently.

In Experiment 2, the stimulative effects of the indirect tax cut are much weaker, partly because government transfers to households are reduced by 10%, thus reducing the latter's income, and partly because government consumption is also cut by 10%, completely neutralizing the strong effects on services seen in Experiment 1. With standard export demand elasticities, the relative price of services now declines; consequently, the effect toward higher prices on the service-intensive consumption goods is absent, and all consumption goods prices decline. The consumer price index falls by almost 11%, compared to 4.6% in Experiment 1. With both high and standard export demand elasticities, imports of services decline, while exports increase, exactly opposite of what happened when there were no compensating government expenditure cuts. In general, the effects on sectoral production are much weaker in Experiment 2 than in Experiment 1. This is also true for macroeconomic aggregates such as GDP and total absorption. Domestic absorption rises by almost 7% while real GDP increases by less than 3% in Experiment 1; in Experiment 2, the increases are 2.6% and 2.3%, respectively.

As mentioned in Chapter 2, one of the foremost concerns for Danish policy makers in connection with tax harmonization is the effect of the tax changes on the balance of payments and the government budget deficit. Even though Denmark has had a small trade surplus in recent years, the current account has remained in deficit due to the heavy costs of servicing Denmark's foreign debt. As Table 4-1 shows, reducing indirect taxes without any compensating changes would more than double the size of the government budget deficit as a proportion of GDP[6], particularly if the export demand elasticities are high[7]. The same is true of the current account deficit. If government spending is cut, the two deficits increase by only about ⅓. Thus, the macroeconomic effects of Experiment 2 show that the expansionary impact of the indirect tax reductions can be neutralized to a large degree; of course, the composition of total absorption will change markedly under such a policy, away from public and toward private consumption.

Simulations of Abolition of the CAP

Abolition of the Common Agricultural Policy would have several direct effects on the Danish economy. As discussed above, the CAP has kept agricultural prices within the EC considerably above world prices. In addition, the EAGGF subsidizes agricultural export to countries outside the EC, thereby exerting a depressing influence on world prices. Hence, from Denmark's point of view, if the CAP were abolished, there would be three main effects: (1) export and import prices of agricultural products would decline to the world level; (2) mitigating this somewhat, world prices would rise due to the decline in EC net exports; and (3) Denmark would no longer receive the EAGGF subsidies. Accordingly, I conduct four experiments. In all four experiments, the EAGGF subsidies, equal to 6.802 billion DKR in the base SAM[8], are set to 0, thus increasing the government's net transfers abroad by that amount. The experiments differ in their assumptions about the movement in world prices following CAP liberalization. In Experiment 1, world prices are unchanged; in Experiment 2, they rise by 10% following CAP abolition, and in Experiment 3 the increase is 20%. Finally, in Experiment 4, world prices rise to a level sufficiently high so that Denmark's export and import prices are unaffected by the liberalization. This last scenario is obviously not very realistic, but it was included as an extreme[9].

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[6] It is interesting to note that the indirect tax cuts, if applied to the base SAM, imply a reduction in government revenues of 33.2 billion DKR. The increase in the budget deficit in Experiment 1 with standard elasticities turns out to be 21.7 billion DKR. Thus, 11.5 billion DKR, or 35% of the base tax cut, "comes back" to the Treasury due to increased sales of the taxed goods.

[7] With high export demand elasticities, *nominal* GDP declines. Since tax rates are applied to nominal incomes and sales, this reduces the government's tax revenue. At the same time, government transfer payments are fixed in nominal terms. The budget deficit in Experiment 1 is approximately 39 billion DKR with standard elasticities and 43 billion DKR with high elasticities, while nominal GDP is 588 billion DKR and 540 billion DKR, respectively.

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[8] Specifically, 5.034 billion DKR in export subsidies and 1.768 billion DKR in production subsidies.

[9] In fact, some authors, such as Sørensen and Pultz (1986), speculate that world prices would indeed rise enough to maintain constant export prices for Denmark.

In concrete terms, I have assumed that current EC prices are 50% above world prices--a reasonable guess given the results cited in Rosenblatt et al. (1988) and elsewhere. Experiment 1 then translates into a 33% drop in the prices confronting Danish agriculture after CAP liberalization; Experiments 2 and 3 imply a 27% drop and a 20% drop, respectively, while Experiment 4 implies unchanged external prices[10]. Table 4-4 shows the resulting price changes.

Obviously, prices of agricultural commodities--domestic, exports, and imports--decline; the decline diminishes when world prices increase. In fact, in Experiment 4, with the world price rising to the original internal EC level, PWE_{AG} increases slightly. To understand this seemingly paradoxical result, one must keep in mind that the domestic and export prices are jointly determined by the interaction of the domestic supply curve and the domestic and foreign demand curves. The reduction in export subsidies has an effect equivalent to a downward shift of the foreign demand curve and puts downward pressure on price. The reduction in production subsidies is equivalent to an increase in production costs and thus shifts the supply curve upwards, which tends to increase price (however, since the production subsidies in the base case are relatively small, this effect is minor). Finally, the increase in the exogenous world price is equivalent to an upward shift in the foreign demand curve. In Experiment 4, due to the large increase in the world price, this last effect dominates and PWE_{AG} rises. When the export demand elasticities are infinite, PWE_{AG} is completely determined by the world price.

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[10] The calculations are as follows: if Danish agriculture currently sells its products at 1.5 times world prices, and world prices are unchanged following abolition of the CAP, then the decline in price as seen from Denmark will be (1.5-1.0)/1.5, or 33%. Similarly for the other cases.

Table 4-4. Experiment Results - Prices.

	STANDARD ELASTICITIES			
	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change from base -----			
Household consumption	-10.2	-8.8	-7.2	-2.4
FOOD	-24.5	-20.7	-16.3	-3.7
BT	-21.7	-18.4	-14.6	-3.5
CL	-3.6	-3.2	-2.7	-1.2
RFP	-6.4	-5.8	-4.9	-2.3
FURN	-4.1	-3.7	-3.1	-1.4
MED	-5.7	-5.1	-4.3	-2.0
TC	-5.4	-4.9	-4.2	-1.9
LEIS	-6.7	-5.9	-4.9	-2.0
MISC	-6.3	-5.7	-4.9	-2.2
Domestic AG	-31.0	-26.4	-20.9	-5.3
Domestic IN	-4.1	-3.6	-3.1	-1.4
Domestic SE	-6.9	-6.2	-5.3	-2.5
Imported AG	-33.0	-27.0	-20.0	0.0
Imported IN	0.0	0.0	0.0	0.0
Imported SE	0.0	0.0	0.0	0.0
Composite AG	-31.5	-26.5	-20.7	-4.2
Composite IN	-1.6	-1.5	-1.2	-0.5
Composite SE	-6.7	-6.0	-5.2	-2.4
Exported AG	-24.9	-19.9	-14.0	3.0
Exported IN	-4.1	-3.6	-3.1	-1.4
Exported SE	-6.9	-6.2	-5.3	-2.5
Labor	-8.1	-7.3	-6.3	-3.0
Capital-AG	-62.9	-55.4	-46.1	-17.0
Capital-IN	2.4	2.1	1.7	0.5
Capital-SE	-6.4	-5.9	-5.1	-2.7

Table 4-4 -- continued.

	HIGH ELASTICITIES			
	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change from base -----			
Household consumption	-6.6	-5.6	-4.4	-1.1
FOOD	-26.8	-22.8	-18.1	-4.6
BT	-22.6	-19.2	-15.2	-3.9
CL	-0.1	-0.1	-0.1	0.0
RFP	-0.1	-0.1	-0.1	0.0
FURN	-0.1	-0.1	-0.1	0.0
MED	-0.1	-0.1	-0.1	0.0
TC	0.0	0.0	0.0	0.0
LEIS	-2.2	-1.9	-1.5	-0.4
MISC	-0.1	-0.1	-0.1	0.0
Domestic AG	-38.4	-32.9	-26.5	-8.1
Domestic IN	0.0	0.0	0.0	0.0
Domestic SE	0.0	0.0	0.0	0.0
Imported AG	-33.0	-27.0	-20.0	0.0
Imported IN	0.0	0.0	0.0	0.0
Imported SE	0.0	0.0	0.0	0.0
Composite AG	-37.3	-31.7	-25.2	-6.4
Composite IN	0.0	0.0	0.0	0.0
Composite SE	0.0	0.0	0.0	0.0
Exported AG	-33.0	-27.0	-20.0	0.0
Exported IN	0.0	0.0	0.0	0.0
Exported SE	0.0	0.0	0.0	0.0
Labor	-0.6	-0.6	-0.6	-0.4
Capital-AG	-80.4	-72.4	-62.0	-26.5
Capital-IN	6.6	5.8	4.8	1.7
Capital-SE	3.7	3.3	2.8	1.2

Domestic and export prices for industry and services also decline, partly due to the lower cost of intermediate inputs from agriculture, and partly due to lower labor costs, which benefit both industry and services. As one might expect, with fixed sectoral capital stocks, the price of agricultural capital declines sharply in both elasticity scenarios, especially in the high-elasticity case.

Prices of consumer goods consequently decline. The overall consumer price index (i.e., the price shown on the "Household consumption" line in Table 4-4) declines for all four experiments in both elasticity scenarios. The CPI decline is greater than the decline in the wage rate in all cases except Experiment 4 with standard elasticities, indicating an increasing real wage. Naturally, the consumer categories with the highest percentage of agricultural inputs--food, beverages and tobacco, and, to a lesser degree, leisure and entertainment--experience the greatest price reductions.

Table 4-5 shows the impacts of the experiments on quantities in the economy. Turning to the aggregate impacts first, one sees that total absorption increases between 1% and 2%, depending on the experiment and scenario, in the three experiments involving falling export prices for Danish agriculture, while real GDP is virtually unchanged.

Household consumption increases for most commodities and in the aggregate (except in Experiment 4). The increase in food consumption is relatively small despite the fall in its relative price, due to the low own-price and income elasticities of demand for food. The increase is greatest for beverages and tobacco; although the demand for those goods is also inelastic, it is much less so than for food, and the relative price of BT falls almost as much as that of food.

Table 4-5. Experiment Results - Quantities.

	STANDARD ELASTICITIES			
	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change from base -----			
Household consumption	2.7	2.1	1.4	-0.3
FOOD	4.4	3.5	2.5	0.2
BT	12.2	9.7	6.9	0.6
CL	-0.5	-0.6	-0.8	-1.0
RFP	1.7	1.3	0.9	-0.1
FURN	0.0	-0.3	-0.6	-1.2
MED	2.2	1.6	1.0	-0.6
TC	1.7	1.2	0.6	-0.6
LEIS	2.8	2.1	1.4	-0.5
MISC	2.5	1.9	1.3	-0.2
Gov't consumption	0.0	0.0	0.0	0.0
Investment	0.0	0.0	0.0	0.0
Total domestic absorption	1.5	1.2	0.8	-0.1
Real GDP	0.3	0.3	0.3	0.1
Production-AG	-26.4	-21.9	-17.1	-5.1
Production-IN	7.6	6.8	5.7	2.4
Production-SE	1.2	1.1	0.8	0.2
Exports-AG	-43.3	-37.2	-30.5	-13.9
Exports-IN	11.0	9.7	8.1	3.5
Exports-SE	7.5	6.7	5.6	2.5
Imports-AG	-7.5	-9.5	-11.3	-14.6
Imports-IN	-0.1	-0.0	-0.0	-0.1
Imports-SE	-2.8	-2.6	-2.3	-1.3

Table 4-5 -- continued.

	HIGH ELASTICITIES			
	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change from base -----			
Household consumption	4.1	3.3	2.4	0.1
FOOD	6.6	5.2	3.9	0.8
BT	17.6	14.1	10.5	2.1
CL	2.0	1.6	1.0	-0.2
RFP	1.7	1.3	0.8	-0.2
FURN	2.9	2.2	1.4	-0.3
MED	3.4	2.6	1.7	-0.4
TC	2.8	2.1	1.4	-0.3
LEIS	4.7	3.8	2.7	0.1
MISC	2.5	1.9	1.3	-0.3
Gov't consumption	0.0	0.0	0.0	0.0
Investment	0.0	0.0	0.0	0.0
Total domestic absorption	2.3	1.8	1.3	0.1
Real GDP	0.1	0.2	0.3	0.2
Production-AG	-42.3	-35.2	-27.8	-9.8
Production-IN	4.9	4.3	3.6	1.4
Production-SE	2.9	2.6	2.3	1.0
Exports-AG	-79.4	-67.3	-54.7	-24.3
Exports-IN	9.4	8.2	6.8	2.6
Exports-SE	29.5	27.2	24.1	12.9
Imports-AG	-36.1	-33.1	-30.0	-22.5
Imports-IN	0.3	0.4	0.4	0.1
Imports-SE	0.7	0.6	0.5	0.0

Consumption of commodities which have high industry input coefficients--clothing and household equipment--increases the least, and actually declines in the standard trade elasticities scenario. Table 4-4 reveals the underlying reason: although all consumer prices decline, the prices for those commodities decline by smaller percentages, so that their relative prices increase. Consumers respond to this by reallocating their consumption away from those goods. The small decline in the price of industry-dependent consumer goods is in turn a consequence in the relatively small decline in industrial commodity prices, which increases their relative price compared to agricultural and service goods[11].

Both the industrial and services sectors benefit from lower agricultural prices, as noted above. Both sectors expand production and exports; with standard elasticities, this effect is greatest for the industrial sector, largely because the export demand for its products is more elastic, and hence the decline in PWE leads to much larger export quantity. Since import prices do not change (this is the small country assumption), the price movements imply a reduction in the relative price of domestic versus foreign industrial goods--in other words, Danish industry and services become more competitive, both on world markets and at home. Therefore, imports decline while exports increase. Agricultural exports, imports, and production decline sharply, especially exports. This holds true even when world prices of agricultural products are assumed to rise to the internal EC level, because even in that case there is still the effect of the abolition of production subsidies to agriculture.

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[11] If the transition from produced goods to consumer goods had been modeled in a way which allows substitution (rather than the fixed-coefficients approach used here), the impact of relatively higher industrial prices on consumer goods prices would have been smaller.

In summary, CAP liberalization has a large negative impact on the agriculture sector, even if world prices were to increase to the previous EC support level, an extremely unlikely occurrence, while the other two sectors gain. Consumers obviously gain from lower prices, and domestic welfare (as measured by total domestic absorption) increases slightly. However, as Table 4-6 shows, the macroeconomic consequences of CAP abolition in this model are very undesirable, particularly from the point of view of external balance. The reduction in agricultural net exports is not sufficiently counterbalanced by the other two sectors, so the trade balance deteriorates in all experiments with the exception of the unrealistic Experiment 4. In addition, the current account worsens even more since a transfer from the EAGGF of almost 7 billion DKR is lost. The government budget deficit also deteriorates because GDP and hence tax receipts fall in nominal terms, while all government transfers (about half of the budget) are fixed in nominal terms. Thus, welfare improves really only in the short term; in the long term, the deteriorating internal and external balances are bound to have negative consequences for the standard of living.

As mentioned in the introduction to this chapter, the CAP (as well as the tax) experiments were also conducted with a different macroeconomic closure, one which specifies unchanged current account and government budget deficits. The next section presents the results of those simulations.

Table 4-6. Experiment Results for Macroeconomic Balances.

STANDARD ELASTICITIES

	Base	Exp. 1	Exp. 2	Exp. 3	Exp. 4
	------------------	% OF GDP	------------------		
Trade	1.3	-1.5	-1.1	-0.5	1.3
Current Account	-3.3	-7.0	-6.6	-6.0	-4.3
Gov't Budget	-3.2	-6.0	-5.6	-5.2	-3.9

HIGH ELASTICITIES

	Base	Exp. 1	Exp. 2	Exp. 3	Exp. 4
	------------------	% OF GDP	------------------		
Trade	1.3	-0.7	-0.4	-0.0	1.4
Current Account	-3.3	-6.1	-5.8	-5.4	-4.2
Gov't Budget	-3.2	-5.2	-4.9	-4.7	-3.8

Simulations with Alternative Closure Rules

In this section, I report results of simulations of indirect tax cuts and CAP abolition carried out with a savings-driven version of the model, in which the labor market is still neoclassical, i.e., full employment is assumed. As mentioned earlier, investment and government consumption are endogenous with this closure, while the current account deficit (i.e., foreign savings) and the government budget deficit (government savings, here negative) are exogenous. Such a specification is relevant for Denmark because macroeconomic management of the economy has primarily focused on keeping those two deficits within reasonable levels at least since 1982[12]. This savings-driven model was further varied with respect to the exchange rate specification. In the basic version of the model, the exchange rate continues to be fixed and serves as the numeraire; as discussed below, I consider this specification to be the most realistic one in view of the commitment to stable currencies within the EMS. However, a savings-driven model with a flexible exchange rate was also specified. In this model, the price of household consumption (i.e., the consumer price index) serves as the numeraire.

In addition to varying the macroeconomic closure, I also varied the labor market closure within the framework of the investment-driven model. In the model with a Keynesian labor market, the real wage is exogenous while employment is endogenous. This version of the model uses the consumer price index as numeraire, and the exchange rate is flexible. Since no labor supply function is included in the model, I am implicitly assuming that labor supply is infinitely elastic--this is obviously an extreme description of the labor market.

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[12] In 1982, a center-right government ideologically committed to privatization and reduced taxes replaced the Social Democratic administration which had ruled the country for much of the postwar period. In practice, however, the government has not had much success in enacting the more ideological elements of its program due to its very slim majority in Parliament and the generally fragmented nature of the Danish political system. Additionally, even conservatives in Denmark are in broad agreement with the basic tenets of the welfare state.

It is an open question which of the two labor market models best fits Danish conditions. The official unemployment rate for most of the 1980s has been between 9% and 10%. It is unclear how far this is from full employment. Paldam (1984) states that full employment in Denmark corresponds to an unemployment rate of somewhere between 4% and 10%, a not very precise estimate. It is clear that the Danish labor market is rigid compared to, say, the U.S.[13], due to features such as very high union membership rates (around 80%) and the generous unemployment benefits. On the other hand, market forces do have an influence on the real wage, since many union contracts leave considerable leeway for local wage adjustments and the system of automatic wage indexation to inflation was largely abolished in the early 1980s. On balance, the neoclassical model is probably more appropriate in a general equilibrium model.

Tables 4-7 and 4-8 show the results of the tax simulations for quantities and prices, respectively, under the savings-driven macroeconomic closure with neoclassical labor market and the investment-driven closure with Keynesian labor market. All the alternative versions of the model discussed in this section use the standard export demand elasticities of 5.0 for agriculture, 2.5 for industry, and 1.0 for services. As in the previous section, Experiment 1 involves reducing indirect taxes without any compensating changes in other policy-variables. Experiment 2 also remains the same in the sense that exogenous domestic government spending is reduced by 10%; however, in the savings-driven version of the model, only transfers to households are exogenous, while in the investment-driven model both transfers and government consumption are exogenous. Thus, the definition of Experiment 2 varies depending on whether the model is investment-driven or savings-driven.

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[13] Many recent political initiatives have sought to make the Danish labor market more flexible. A good discussion is contained in Danish Economic Council (1988).

Comparing Table 4-7 with Table 4-2, one sees a similar expansion in household consumption in all model versions when indirect taxes are cut - both in the aggregate and for the individual consumer goods. The major difference between the savings-driven and investment-driven models (within the neoclassical labor market framework) lies in the sharp decline in government consumption when constant current account and government budget deficits are forced upon the economy. Hence, in Experiment 1 total domestic absorption only rises by 1.5%, compared to 6.9% in the investment-driven model. In the investment-driven model, domestic producer prices increase with a resulting loss of international competitiveness and a decline in net exports; in the savings-driven model all producer prices decline, and no deterioration of the current account takes place. Since government consumption is very service-intensive, the relative price, production, and imports of services fall. Exports of services increase, since the relative price of Danish services has now fallen compared to the world price. Since services are labor-intensive, the wage rate and the price of capital in this sector both decline.

Table 4-7. Tax Simulations with Varying Closures - Quantities.

Macro closure:	SAVINGS		INVESTMENT		SAVINGS	
Labor market:	NEOCLASSICAL		KEYNESIAN		NEOCLASSICAL	
Exchange rate:	FIXED		FLEXIBLE		FLEXIBLE	
	EX 1	EX 2	EX 1	EX 2	EX 1	EX 2
	---------- % change from base -----------					
Household consumption	11.5	9.1	14.5	9.3	8.6	6.6
FOOD	2.1	1.6	2.0	0.7	1.5	1.2
BT	40.8	38.6	41.3	35.0	37.9	36.1
CL	10.9	8.7	11.7	5.5	8.0	6.2
RFP	2.8	0.8	6.3	2.7	0.4	-1.2
FURN	4.3	1.4	6.2	-1.4	0.5	-1.8
MED	5.6	1.7	11.1	3.1	0.8	-2.3
TC	38.2	34.0	44.0	35.0	32.9	29.5
LEIS	4.0	1.3	7.1	0.8	0.6	-1.6
MISC	5.5	2.4	10.9	5.2	1.7	-0.8
Government consumption	-19.1	-13.6	0.0	-10.0	-12.9	-8.4
Investment	0.5	-1.0	0.0	0.0	-1.5	-2.7
Total domestic absorption	1.5	1.3	8.0	2.5	1.1	0.9
Total employment	0.0	0.0	17.5	13.1	0.0	0.0
Real GDP	2.5	2.2	12.1	8.9	2.1	1.9
Production-AG	2.8	2.1	11.7	13.1	2.2	1.6
Production-IN	4.3	3.1	20.1	21.8	3.2	2.2
Production-SE	-1.4	-1.1	8.4	3.9	-1.1	-0.7
Exports-AG	0.8	0.3	11.4	14.4	0.5	0.0
Exports-IN	4.4	3.3	21.8	25.9	3.5	2.6
Exports-SE	4.5	3.3	15.4	19.6	3.5	2.5
Imports-AG	3.6	3.2	4.9	3.5	3.0	2.7
Imports-IN	2.5	1.6	9.3	7.2	1.4	0.7
Imports-SE	-4.0	-3.0	0.4	-6.1	-3.1	-2.2

Table 4-8. Tax Simulations with Varying Closures - Prices.

Macro closure:	SAVINGS		INVESTMENT		SAVINGS	
Labor market:	NEOCLASSICAL		KEYNESIAN		NEOCLASSICAL	
Exchange rate:	FIXED		FLEXIBLE		FLEXIBLE	
	EX 1	EX 2	EX 1	EX 2	EX 1	EX 2
	---------- % change from base -----------					
Household consumption	-12.9	-12.3	0.0	0.0	0.0	0.0
FOOD	-11.3	-11.0	5.3	6.5	1.5	1.2
BT	-43.0	-42.7	-32.9	-32.4	-34.7	-34.8
CL	-11.9	-11.5	3.2	4.1	0.9	0.7
RFP	-4.3	-3.3	7.7	6.8	10.2	10.4
FURN	-3.9	-3.3	11.8	12.4	10.3	10.1
MED	-4.2	-3.4	9.0	8.6	10.2	10.3
TC	-24.5	-23.9	-13.9	-14.2	-13.2	-13.1
LEIS	-4.1	-3.4	10.2	10.2	10.2	10.2
MISC	-5.3	-4.3	6.7	5.8	9.1	9.3
Domestic AG	-0.2	-0.1	20.5	22.7	14.0	13.4
Domestic IN	-1.7	-1.3	13.8	15.0	12.6	12.3
Domestic SE	-4.3	-3.2	6.7	5.4	10.3	10.6
Imports-AG	0.0	0.0	23.1	26.0	14.1	13.4
Imports-IN	0.0	0.0	23.1	26.0	14.1	13.4
Imports-SE	0.0	0.0	23.1	26.0	14.1	13.4
Composite AG	-0.1	0.0	21.1	23.4	14.1	13.4
Composite IN	-0.7	-0.5	19.3	21.5	13.5	13.0
Composite SE	-4.1	-3.1	7.3	6.1	10.5	10.7
Exports-AG	-0.2	-0.1	20.5	22.7	14.0	13.4
Exports-IN	-1.7	-1.3	13.8	15.0	12.6	12.3
Exports-SE	-4.3	-3.2	6.7	5.4	10.3	10.6
Labor	-4.1	-3.0	0.0	0.0	10.5	10.8
Capital-AG	4.0	3.1	38.6	43.7	17.8	16.3
Capital-IN	2.1	1.5	31.0	33.8	15.7	14.4
Capital-SE	-6.2	-4.6	12.8	5.9	8.7	9.6
Exchange rate	0.0	0.0	23.1	26.0	14.1	13.4

For Experiment 2, the results are not as dramatically different between the investment-driven and the savings-driven model. This is not surprising, since this experiment already involved an exogenous cut in government consumption in the original model. With the savings-driven model, the now endogenously determined size of that cut is slightly higher (13.6% versus 10%), but the broad pattern of production, trade, and prices is similar for the two model closures. The savings-driven model is somewhat more restrictive (in the sense of requiring reductions in components of domestic demand), and as a result, domestic absorption only increases by 1.3% in Table 4-7, compared to 2.6% in Table 4-2.

When the labor market closure is changed from neoclassical to Keynesian, the impact on the results is dramatic. In Experiment 2, employment increases by 17.5%--a figure which implies not only a big reduction in the ranks of the unemployed but also a considerable increase in the labor force. Even when government spending is cut in Experiment 2, the expansion in employment is still over 13%. It is extremely doubtful that such an increase in labor supply would be forthcoming, given that the real wage is kept constant. It is clear that the assumption of completely elastic labor supply is so unrealistic that one simply cannot regard these results seriously.

The other previously exogenous variable now free to adjust is the exchange rate, whose response to the demand increase resulting from lower consumption taxes is a devaluation of the DKR of 23% in Experiment 1 and 26% in

Experiment 2[14]. As a consequence, domestic and export prices rise less than import prices--Danish producers become more competitive internationally--and the trade surplus increases compared to the standard model, even in Experiment 1, as Table 4-9 shows. Production and exports in all three sectors increase, total domestic absorption rises by 8% in Experiment 1 and 2.5% in Experiment 2. Indeed, if the labor market really were Keynesian and the exchange rate flexible, Experiment 2 would not even be necessary--the indirect tax cut would pay for itself in the form of increased government revenue from higher economic activity and higher net exports, and no compensating measures would be needed.

Unfortunately, the rosy scenario resulting from the Keynesian labor market closure is not realistic, partly due to the elastic labor supply assumption, and partly due to the fact that the trade balance improvement hinges on a large devaluation of the Danish currency--a move which appears extremely unlikely given the stability within the European Monetary System in recent years. In fact, the Danish currency has not been devalued since 1983, and recent trends toward Economic and Monetary Union (EMU) make future devaluations unlikely. Thus, for the foreseeable future, Denmark will have fixed exchange rates *vis a vis* the countries with which it conducts the bulk of its foreign trade.

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[14] Recall that the exchange rate is defined as the DKR price of foreign currency.

Tables 4-7 and 4-8 also show the results from the model with a neoclassical labor market and a flexible exchange rate[15]. As one might expect, the DKR depreciates significantly following the tax cuts, by 14.1% in Experiment 1 and 13.4% in Experiment 2. This makes consumption goods more expensive, *ceteris paribus*, and so the increase in consumption is smaller than was the case with fixed exchange rates. Government consumption, on the other hand, is not very import-intensive, and the decline in this demand category is therefore smaller with flexible exchange rates--government consumption falls by 12.9% in Experiment 1 with flexible exchange rates, compared to a fall of 19.1% with fixed exchange rates. The impacts of the experiments on absorption, real GDP, production, exports, and imports are similar in the two models with neoclassical labor markets. On balance, it appears that the tax changes lead to a somewhat lesser degree of dislocation in the economy when exchange rates are flexible; however, as noted above, a large devaluation of the Danish currency is extremely unlikely in the present political context.

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[15] The reader should note that the absolute price changes are not directly comparable between the fixed and flexible exchange rate models, because the prices are normalized around different magnitudes--the exchange rate in the former set of models and the consumer price index in the latter. Thus, although the price changes in Table 4-8 appear to be very different between, say, the first and the fifth columns, the *relative* price changes follow similar patterns. For example, in Experiment 1, with fixed exchange rates the wage rate falls by 4.1% while the consumer price index falls by 12.9%; with flexible exchange rates, the wage increases by 10.5% while the CPI is unchanged. Both situations represent roughly equivalent increases in the real wage.

Table 4-9. Macroeconomic Balances with Varying Closures.

Macro closure:		SAVINGS		INVESTMENT		SAVINGS	
Labor market:		NEOCLASSICAL		KEYNESIAN		NEOCLASSICAL	
Exchange rate:		FIXED		FLEXIBLE		FLEXIBLE	
	Base	EX 1	EX 2	EX 1	EX 2	EX 1	EX 2
	% OF GDP						
Trade	1.3	1.2	1.2	1.9	3.8	1.4	1.4
Current Account	-3.3	-3.6	-3.5	-2.5	-0.5	-3.1	-3.1
Gov't Budget	-3.2	-3.5	-3.4	-3.1	-0.4	-3.0	-3.0

NOTE: The nominal balances are held constant in the savings-driven models. Since nominal GDP changes, the balances as a proportion of GDP change slightly as well.

The remainder of this chapter is devoted to simulations of CAP liberalization under alternative model closures. The four experiments from the previous section are retained unchanged, and as with the tax simulations, only the results using the standard export demand elasticities are presented. The three alternative closures studied are again (1) savings-driven model with neoclassical labor market and a fixed exchange rate, (2) investment-driven model with Keynesian labor market and a flexible exchange rate, and (3) savings-driven model with neoclassical labor market and a flexible exchange rate. Quantity results are shown in Table 4-10, while

Table 4-11 shows the price results. Macroeconomic balances are shown in Table 4-12.

As was shown in Table 4-6, the small welfare improvements which resulted from abolishing the CAP in the standard model were gained at the expense of considerable worsening of the economy's external and internal balance. Table 4-10 shows that if the reductions in government spending needed to maintain the current account and government deficits are taken into account, as is done in the savings-driven model, CAP liberalization is unambiguously welfare-reducing for Denmark. Total domestic absorption declines between 2 and 4%, depending on the behavior of world prices following the abolition of agricultural support. This is true regardless of whether the exchange rate is fixed or flexible. With a fixed exchange rate, in the most realistic scenarios (Experiments 2 and 3, in which world prices increase by 10 and 20%, respectively), the small increase in private consumption is more than offset by falling government consumption and investment. With a flexible exchange rate, household consumption declines, and private investment declines even more than it did in the fixed-exchange rate scenario. Government consumption, being the least import-intensive demand category, and hence relatively less affected by the devaluation of the DKR, declines less when the exchange rate is flexible.

Table 4-10. CAP Experiment Results - Quantities.

SAVINGS-DRIVEN MODEL WITH NEOCLASSICAL LABOR MARKET
AND FIXED EXCHANGE RATE

	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change	from base	-----	
Household consumption	2.0	1.4	0.8	-0.5
FOOD	3.6	2.7	1.9	-0.0
BT	10.1	7.7	5.4	-0.0
CL	-3.7	-3.5	-3.1	-1.9
RFP	2.3	1.9	1.3	0.0
FURN	-3.5	-3.4	-3.1	-2.1
MED	1.6	1.1	0.5	-0.8
TC	0.9	0.5	0.0	-0.8
LEIS	1.3	0.8	0.3	-0.9
MISC	3.4	2.7	1.9	0.0
Gov't consumption	-15.3	-13.3	-10.8	-4.0
Investment	-6.6	-5.8	-4.8	-2.0
Total domestic absorption	-4.1	-3.8	-3.3	-1.7
Total employment	0.0	0.0	0.0	0.0
Real GDP	0.1	0.1	0.1	-0.0
Production-AG	-21.2	-17.2	-13.0	-3.5
Production-IN	18.2	15.7	12.9	4.9
Production-SE	-1.8	-1.6	-1.3	-0.6
Exports-AG	-36.4	-30.9	-25.1	-11.5
Exports-IN	27.0	23.4	19.2	7.4
Exports-SE	20.4	17.7	14.6	5.7
Imports-AG	-9.4	-11.0	-12.4	-14.9
Imports-IN	-0.9	-0.8	-0.8	-0.5
Imports-SE	-12.2	-10.8	-9.1	-3.9

Table 4-10 -- continued.

INVESTMENT-DRIVEN MODEL WITH KEYNESIAN LABOR MARKET AND FLEXIBLE EXCHANGE RATE

	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change	from base	-----	
Household consumption	0.0	-0.3	-0.6	-1.0
FOOD	3.5	2.7	1.9	0.1
BT	9.4	7.3	5.1	0.1
CL	-4.2	-3.8	-3.3	-1.7
RFP	-0.1	-0.3	-0.5	-0.8
FURN	-4.8	-4.4	-3.9	-2.2
MED	-2.2	-2.3	-2.3	-2.0
TC	-2.3	-2.3	-2.3	-1.8
LEIS	-0.9	-1.1	-1.3	-1.5
MISC	-0.3	-0.6	-0.9	-1.3
Gov't consumption	0.0	0.0	0.0	0.0
Investment	0.0	0.0	0.0	0.0
Total domestic absorption	0.0	-0.1	-0.3	-0.6
Total employment	1.6	1.0	0.4	-0.9
Real GDP	0.9	0.6	0.3	-0.5
Production-AG	-24.1	-20.2	-15.9	-5.7
Production-IN	12.6	10.3	7.9	1.4
Production-SE	1.3	0.9	0.6	-0.3
Exports-AG	-40.1	-34.7	-28.8	-14.4
Exports-IN	17.9	14.8	11.3	2.5
Exports-SE	12.7	10.5	8.1	1.8
Imports-AG	-8.7	-10.3	-11.8	-14.7
Imports-IN	0.3	0.1	-0.1	-0.6
Imports-SE	-5.5	-4.7	-3.9	-1.4

Table 4-10 -- continued.

SAVINGS-DRIVEN MODEL WITH NEOCLASSICAL LABOR MARKET AND FLEXIBLE EXCHANGE RATE

	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change	from base -----		
Household consumption	-1.8	-1.8	-1.8	-1.4
FOOD	2.7	2.0	1.3	-0.2
BT	7.3	5.4	3.6	-0.6
CL	-7.0	-6.3	-5.5	-2.7
RFP	-1.2	-1.2	-1.1	-0.8
FURN	-8.4	-7.6	-6.6	-3.3
MED	-5.1	-4.7	-4.2	-2.4
TC	-4.9	-4.5	-4.0	-2.2
LEIS	-3.5	-3.3	-3.1	-2.0
MISC	-2.0	-2.0	-1.8	-1.2
Gov't consumption	-5.6	-5.0	-4.2	-1.8
Investment	-9.2	-8.1	-6.7	-2.6
Total domestic absorption	-4.2	-3.8	-3.3	-1.7
Total employment	0.0	0.0	0.0	0.0
Real GDP	-0.4	-0.3	-0.2	-0.1
Production-AG	-22.3	-18.1	-13.8	-3.8
Production-IN	15.6	13.6	11.2	4.4
Production-SE	-1.0	-1.0	-0.8	-0.5
Exports-AG	-37.3	-31.7	-25.7	-11.8
Exports-IN	24.3	21.2	17.4	6.9
Exports-SE	17.9	15.6	12.9	5.3
Imports-AG	-10.0	-11.4	-12.7	-15.0
Imports-IN	-2.3	-2.1	-1.7	-0.8
Imports-SE	-10.3	-9.2	-7.8	-3.5

I now turn to the sectoral impacts. In the savings-driven model with a fixed exchange rate, the agriculture sector does not suffer quite as much from abolition of the CAP as was the case in the investment-driven model. The declines in production, exports, and the price of agricultural capital are all smaller, and the decline in imports is greater in Table 4-10 than in Table 4-5. As Table 4-11 shows, even though the decline in the producer price of agricultural commodities is greater in the savings-driven model, the decline in relative price is smaller because prices of domestic industry and services also decline, and by a higher percentage than they did in Table 4-4.

The services sector declines somewhat in the savings-driven model, due to the large cut in government consumption and the smaller fall in private investment needed to maintain macroeconomic balance[16]. Because of the decline in services, the price of labor declines by about twice as much as it did in Table 4-4. This, in turn, benefits industry, and the industrial sector increases production and exports considerably, compared to the investment-driven closure. These sectoral impacts are broadly similar in the flexible-exchange rate version of the model[17]. The devaluation of the DKR ranges from 4.3% in Experiment 4 to 19% in Experiment 1.

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[16] Investment is actually services-intensive because a large portion of it is construction.

[17] As noted in footnote 15, the absolute price changes cannot be directly compared in models with different price normalization rules; however, the pattern of *relative* price changes can be compared between the first and the third panel of Table 4-11. For example, both panels show a slight decline in the real wage.

Table 4-11. CAP Experiment Results - Prices.

SAVINGS-DRIVEN MODEL WITH NEOCLASSICAL LABOR MARKET AND A FIXED EXCHANGE RATE

	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change from base -----			
Household consumption	-17.1	-14.9	-12.3	-4.4
FOOD	-28.1	-23.9	-19.0	-4.8
BT	-26.2	-22.4	-17.9	-4.8
CL	-8.4	-7.5	-6.3	-2.6
RFP	-15.5	-13.8	-11.6	-4.9
FURN	-9.8	-8.7	-7.3	-3.1
MED	-13.6	-12.1	-10.2	-4.3
TC	-13.2	-11.7	-9.9	-4.2
LEIS	-13.7	-12.1	-10.1	-4.0
MISC	-15.3	-13.6	-11.5	-4.9
Domestic AG	-32.6	-27.8	-22.1	-5.8
Domestic IN	-9.1	-8.1	-6.8	-2.8
Domestic SE	-16.9	-15.0	-12.7	-5.4
Imports-AG	-33.0	-27.0	-20.0	0.0
Imports-IN	0.0	0.0	0.0	0.0
Imports-SE	0.0	0.0	0.0	0.0
Composite AG	-32.7	-27.6	-21.7	-4.6
Composite IN	-3.7	-3.3	-2.7	-1.1
Composite SE	-16.3	-14.5	-12.3	-5.2
Exports-AG	-26.6	-21.4	-15.2	2.5
Exports-IN	-9.1	-8.1	-6.8	-2.8
Exports-SE	-16.9	-15.0	-12.7	-5.4
Labor	-18.7	-16.7	-14.1	-6.1
Capital-AG	-59.8	-52.3	-43.1	-15.4
Capital-IN	4.0	3.4	2.7	0.8
Capital-SE	-20.9	-18.6	-15.8	-7.0
Exchange rate	0.0	0.0	0.0	0.0

Table 4-11 -- continued.

INVESTMENT-DRIVEN MODEL WITH KEYNESIAN LABOR MARKET AND A FLEXIBLE EXCHANGE RATE

	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change	from base -----		
Household consumption	0.0	0.0	0.0	0.0
FOOD	-14.8	-12.1	-9.2	-1.5
BT	-12.0	-9.9	-7.5	-1.3
CL	8.7	7.2	5.4	1.1
RFP	3.3	2.7	2.0	0.3
FURN	7.7	6.3	4.8	0.9
MED	4.8	3.9	3.0	0.5
TC	5.1	4.2	3.2	0.5
LEIS	4.0	3.3	2.5	0.4
MISC	3.5	2.8	2.1	0.3
Domestic AG	-21.4	-17.8	-13.8	-3.3
Domestic IN	7.9	6.5	5.0	1.0
Domestic SE	2.3	1.8	1.4	0.1
Imports-AG	-22.8	-17.8	-12.3	2.0
Imports-IN	15.3	12.6	9.6	2.0
Imports-SE	15.3	12.6	9.6	2.0
Composite AG	-21.7	-17.8	-13.5	-2.2
Composite IN	12.3	10.1	7.7	1.6
Composite SE	2.7	2.2	1.6	0.2
Exports-AG	-14.4	-10.5	-6.2	5.2
Exports-IN	7.9	6.5	5.0	1.0
Exports-SE	2.3	1.8	1.4	0.1
Labor	0.0	0.0	0.0	0.0
Capital-AG	-55.8	-48.6	-40.1	-15.8
Capital-IN	19.1	15.6	11.8	2.1
Capital-SE	1.9	1.4	0.9	-0.4
Exchange rate	15.3	12.6	9.6	2.0

Table 4-11 -- continued.

SAVINGS-DRIVEN MODEL WITH NEOCLASSICAL LABOR MARKET AND A FIXED EXCHANGE RATE

	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	----- % change from base -----			
Household consumption	0.0	0.0	0.0	0.0
FOOD	-13.7	-11.0	-8.0	-0.5
BT	-11.3	-9.1	-6.7	-0.5
CL	10.0	8.4	6.5	1.8
RFP	2.5	1.8	1.1	-0.4
FURN	8.5	7.1	5.5	1.3
MED	4.5	3.6	2.6	0.2
TC	5.0	4.0	2.9	0.3
LEIS	4.2	3.4	2.6	0.4
MISC	2.6	2.0	1.2	-0.4
Domestic AG	-19.6	-15.9	-11.9	-1.7
Domestic IN	9.1	7.6	5.9	1.6
Domestic SE	1.0	0.5	0.0	-0.9
Imported AG	-20.3	-15.2	-9.6	4.3
Imported IN	19.0	16.2	13.0	4.3
Imported SE	19.0	16.2	13.0	4.3
Composite AG	-19.7	-15.7	-11.4	-0.5
Composite IN	15.0	12.7	10.1	3.2
Composite SE	1.6	1.0	0.5	-0.7
Exported AG	-12.5	-8.5	-4.1	6.9
Exported IN	9.1	7.6	5.9	1.6
Exported SE	1.0	0.5	0.0	-0.9
Labor	-1.1	-1.3	-1.5	-1.6
Capital-AG	-53.1	-45.4	-36.5	-12.1
Capital-IN	22.5	19.1	15.2	4.9
Capital-SE	-2.6	-2.7	-2.7	-2.3
Exchange rate	19.0	16.2	13.0	4.3

Table 4-12. Impact of CAP Abolition on Macro Balances.

SAVINGS-DRIVEN MODEL WITH NEOCLASSICAL LABOR MARKET AND A FIXED EXCHANGE RATE

	BASE	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	-------------	% OF GDP	--------------		
Trade	1.3	1.6	1.7	1.9	2.2
Current Account	-3.3	-4.0	-3.9	-3.8	-3.4
Gov't Budget	-3.2	-3.9	-3.8	-3.7	-3.3

INVESTMENT-DRIVEN MODEL WITH KEYNESIAN LABOR MARKET AND A FLEXIBLE EXCHANGE RATE

Trade	1.3	-0.5	-0.2	0.1	1.3
Current Account	-3.3	-5.5	-5.3	-5.1	-4.3
Gov't Budget	-3.2	-4.0	-4.0	-4.0	-3.8

SAVINGS-DRIVEN MODEL WITH NEOCLASSICAL LABOR MARKET AND A FLEXIBLE EXCHANGE RATE

	BASE	EXP. 1	EXP. 2	EXP. 3	EXP. 4
	-------------	% OF GDP	--------------		
Trade	1.3	1.6	1.7	1.9	2.2
Current Account	-3.3	-3.4	-3.3	-3.3	-3.3
Gov't Budget	-3.2	-3.3	-3.2	-3.2	-3.2

NOTE: The nominal balances are held constant in the savings-driven models. Since nominal GDP changes, the balances as a proportion of GDP change slightly as well.

With Keynesian labor market closure and the investment-driven model, the welfare impact of abolishing the CAP is virtually zero, mainly due to the absence of any reduction in government spending or private investment. Industrial and service exports again expand, while agriculture declines. Employment increases slightly due to the shift from capital-intensive agriculture to the other two, labor-intensive sectors. Producer prices in industry and services increase somewhat, and as a result, consumer prices of all commodities except the two with the highest agriculture content--food and beverages and tobacco--increase compared to the base case[18]. The exchange rate increases (that is, the DKR is devalued), but not enough to prevent some deterioration of the current account, as Table 4-12 shows.

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[18] However, as noted before, changes in consumer goods prices are not directly comparable between this model and the other two, because prices are normalized in different ways. However, changes in relative prices can still be compared.

CHAPTER 5
SUMMARY AND POLICY IMPLICATIONS

Summary

Although several applied general equilibrium analyses of the CAP have been published (some of which are reviewed in Chapter 3), no CGE models of tax harmonization on the individual country level have appeared in the literature. Models of the effects of possible CAP reforms on individual EC members are also rare, especially for the smaller member countries. This study has examined the impacts of reforms in those two areas on Denmark using a relatively simple computable general equilibrium model, which nevertheless has yielded a number of interesting insights. As mentioned in Chapter 4, among the various macroeconomic and labor market closures studied there, I consider the savings-driven specification with the neoclassical labor market and a fixed exchange rate to be the one most relevant for Denmark. Consequently, the discussion in this chapter will focus on results from that model.

The major results of the tax experiments are summarized graphically in Figures 5-1 through 5-6, while Figures 5-7 through 5-12 show the impact of CAP reform.

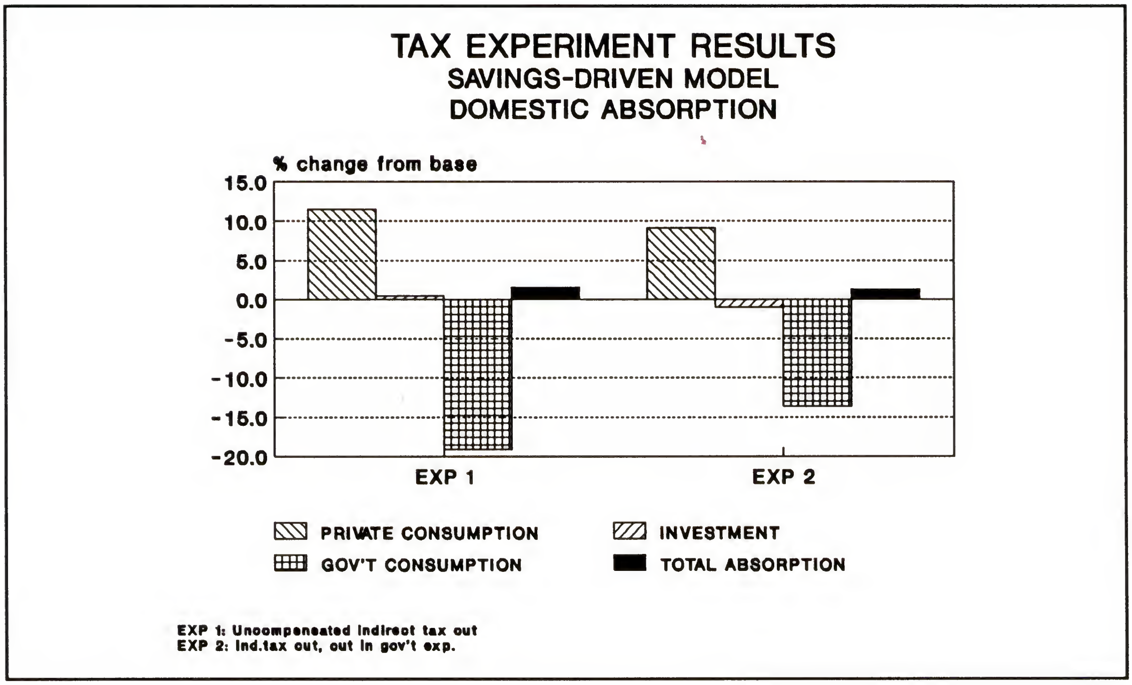


Figure 5-1. Impact of Tax Harmonization on Absorption.

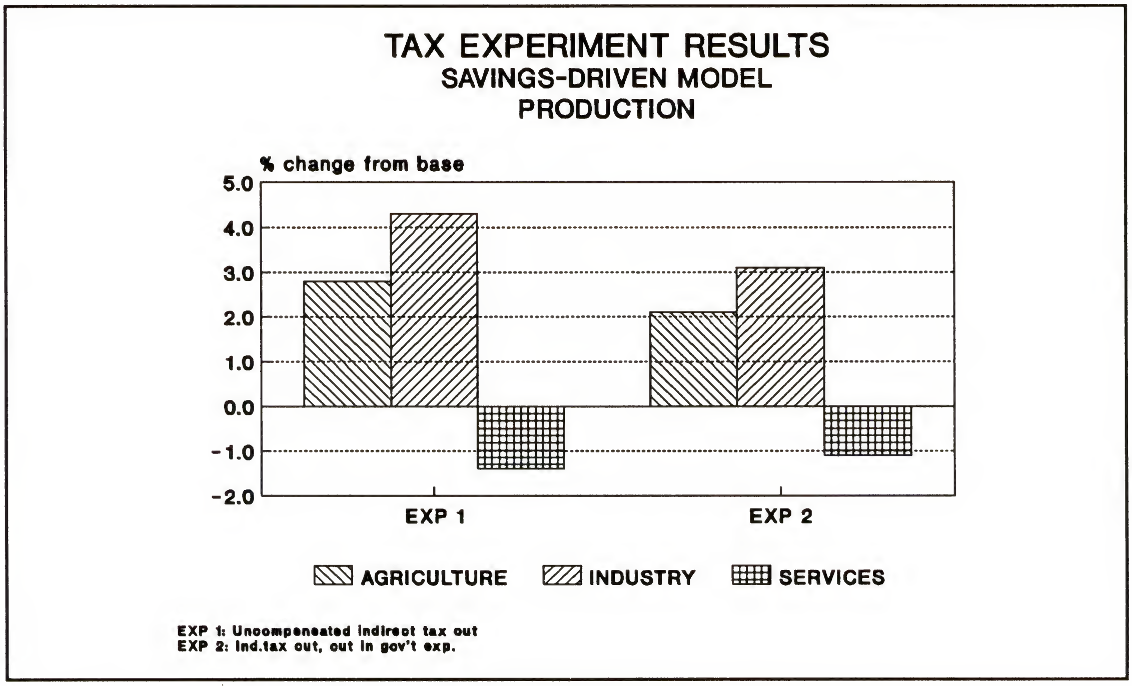


Figure 5-2. Impact of Tax Harmonization on Production.

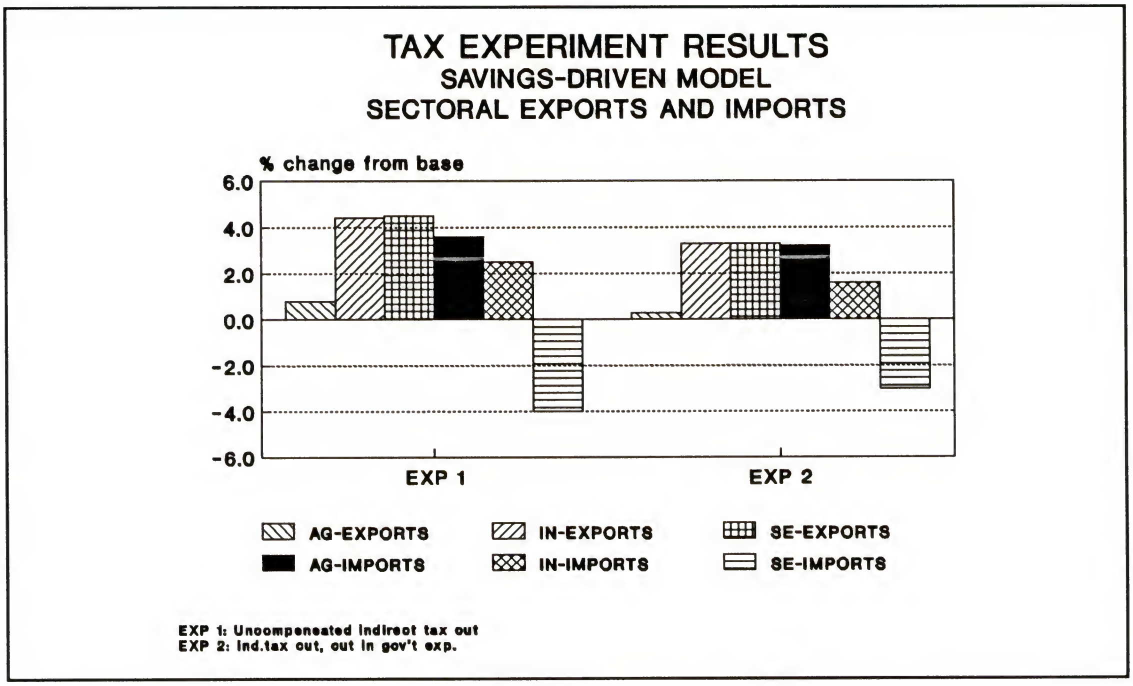


Figure 5-3. Impact of Tax Harmonization on Trade.

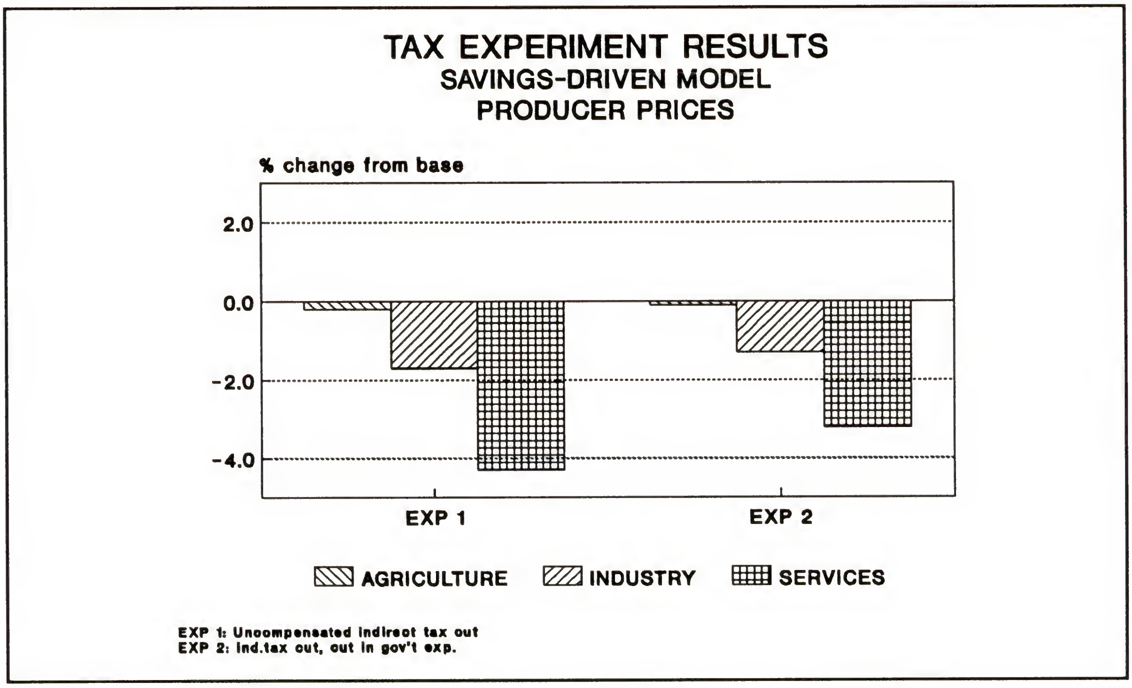


Figure 5-4. Impact of Tax Harmonization on Producer Prices.

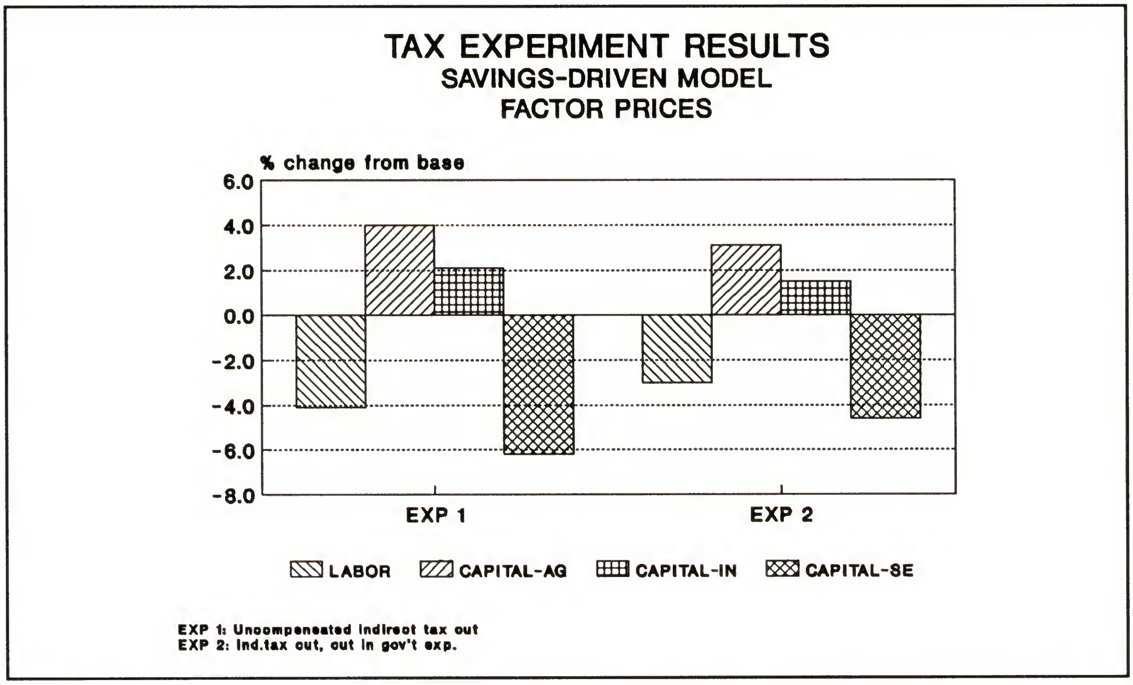


Figure 5-5. Impact of Tax Harmonization on Factor Prices.

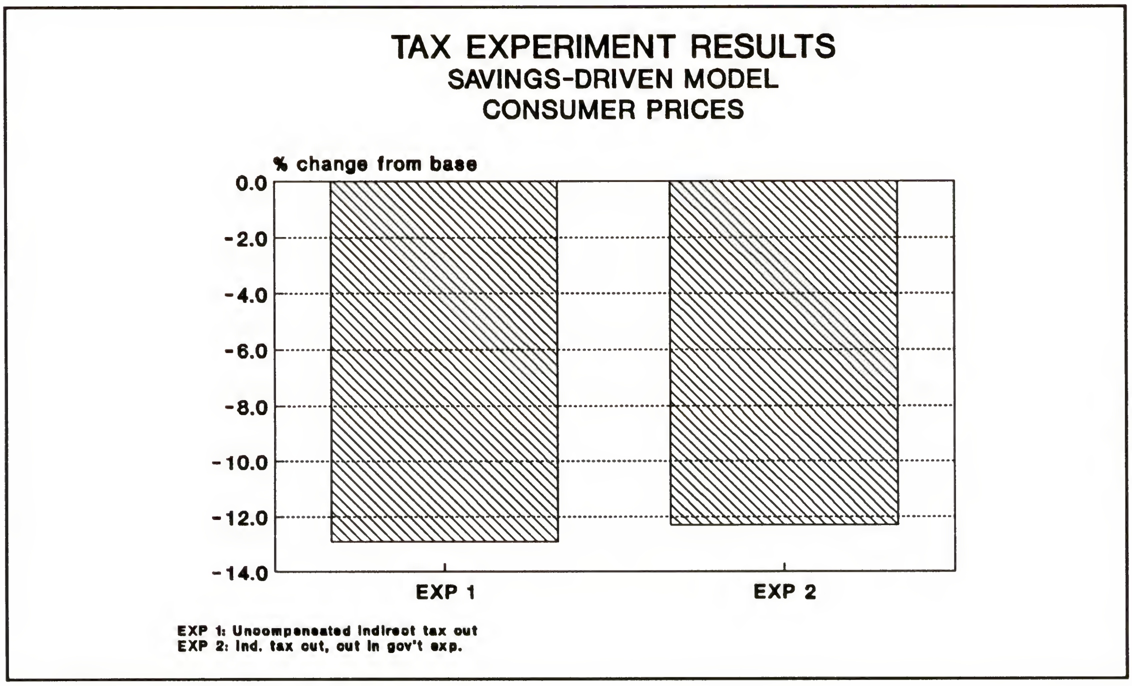
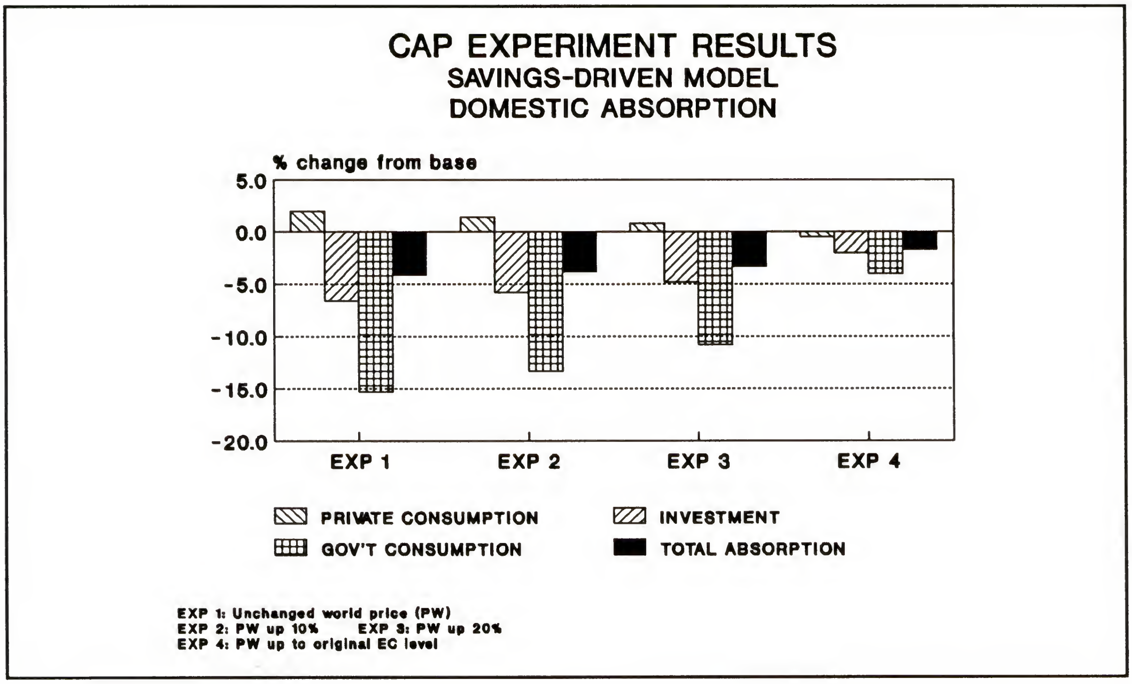
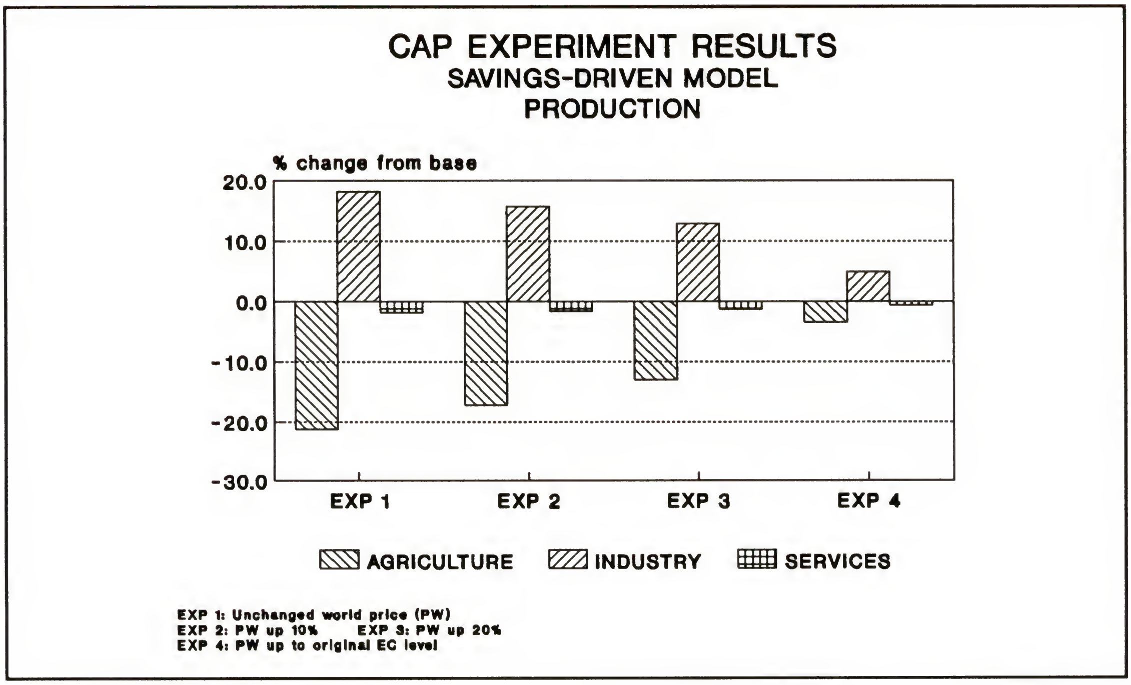


Figure 5-6. Impact of Tax Harmonization on Consumer Prices.



EXP 1: Unchanged world price (PW)
EXP 2: PW up 10%　EXP 3: PW up 20%
EXP 4: PW up to original EC level

Figure 5-7. Impact of CAP Liberalization on Absorption.



EXP 1: Unchanged world price (PW)
EXP 2: PW up 10%　EXP 3: PW up 20%
EXP 4: PW up to original EC level

Figure 5-8. Impact of CAP Liberalization on Production.

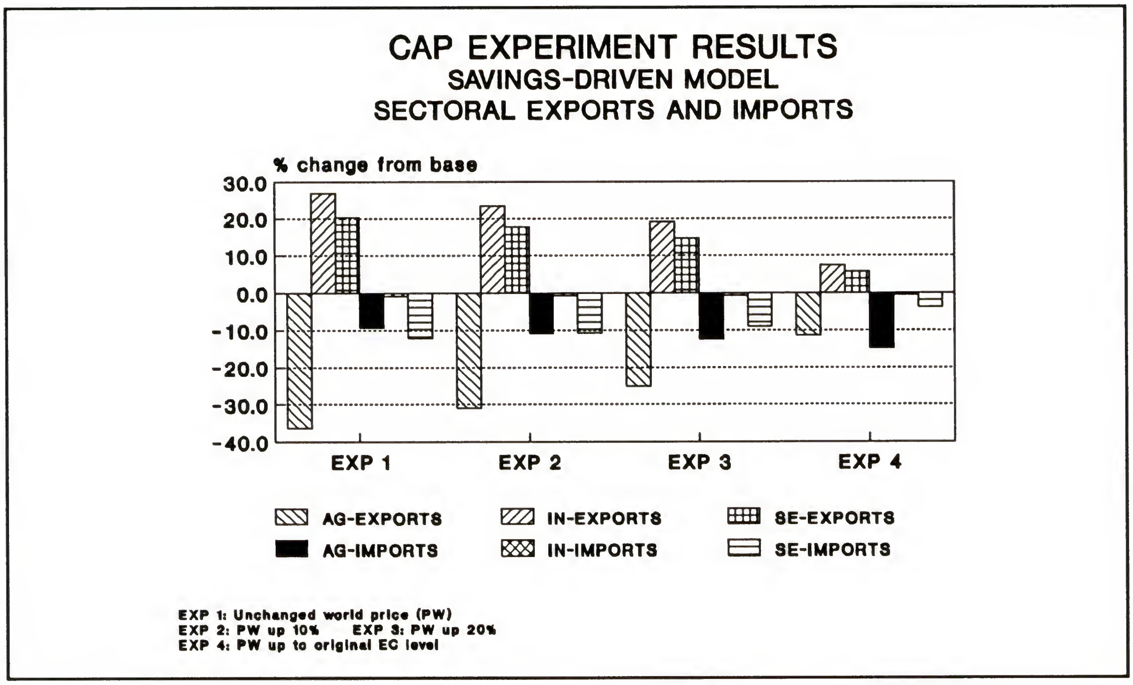


Figure 5-9. Impact of CAP Liberalization on Trade.

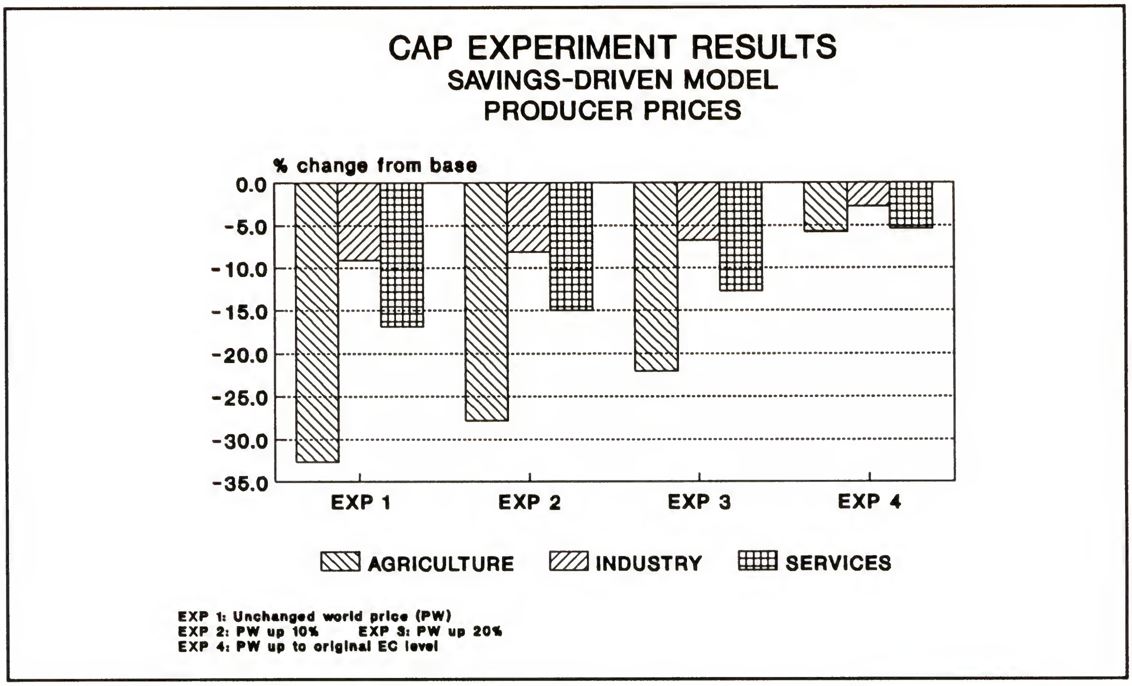


Figure 5-10. Impact of CAP Liberalization on Producer Prices.

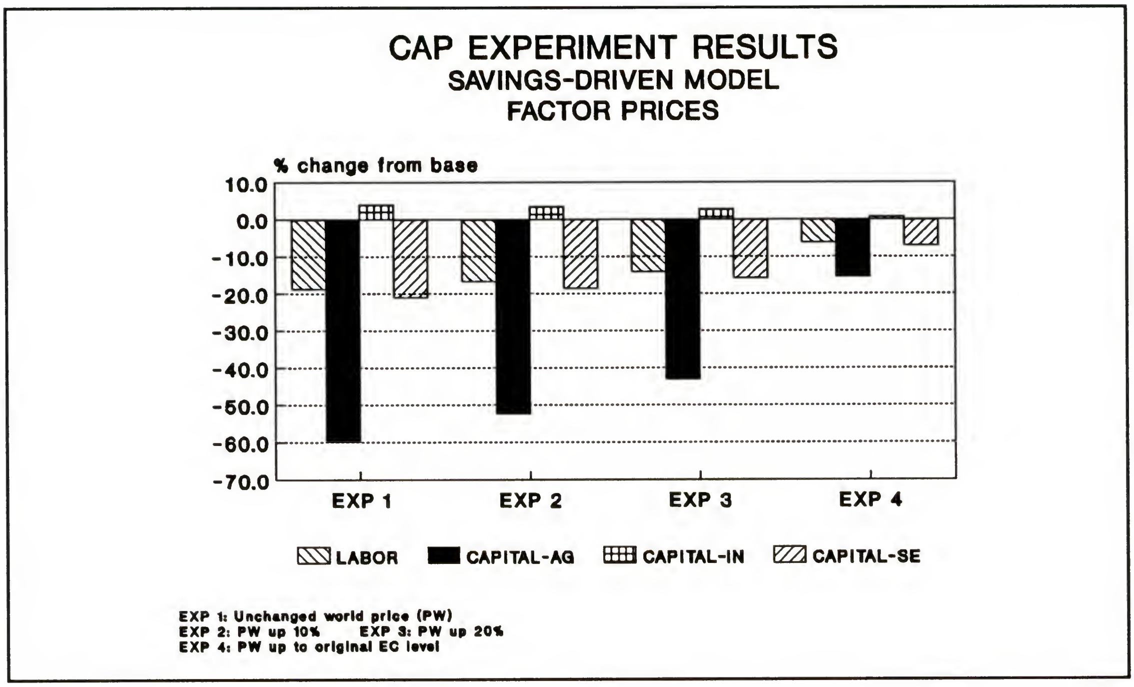


Figure 5-11. Impact of CAP Liberalization on Factor Prices.

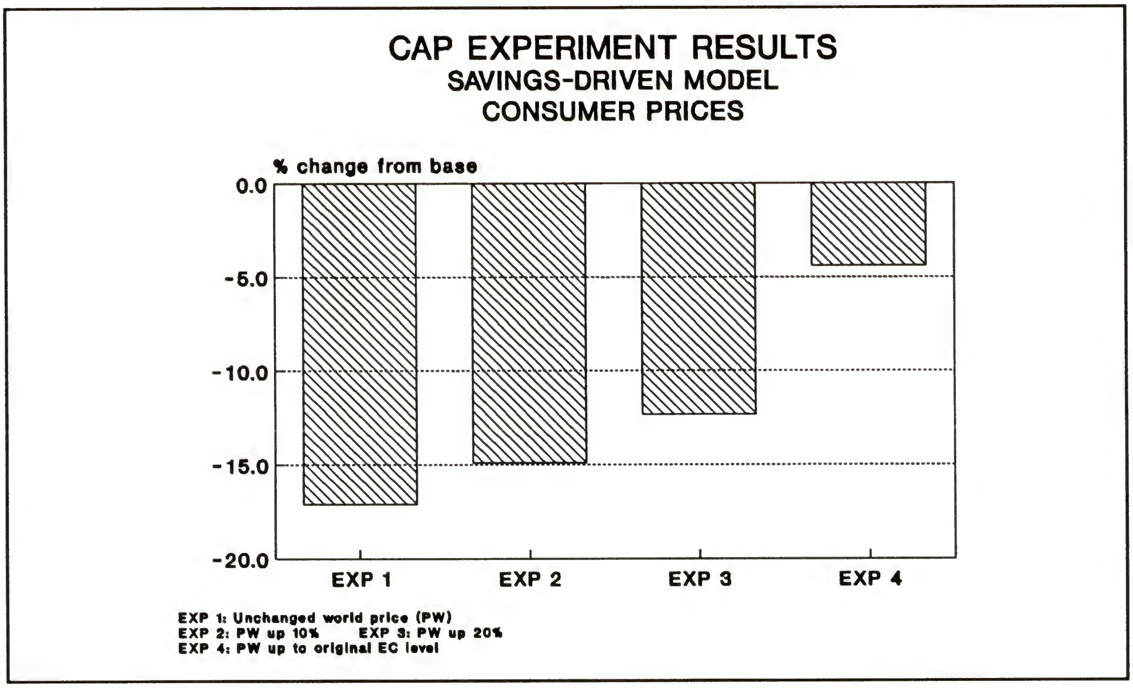


Figure 5-12. Impact of CAP Liberalization on Consumer Prices.

The two main conclusions of this study are: (1) Denmark's adjustment to the new indirect tax regime will likely be quite painful, and (2) Denmark would sustain considerable static losses (on the order of 3-4% of total absorption) if the CAP were abolished. There may be political and economic benefits for Denmark in increased European integration; this study has shown that there are also potentially high costs.

Given the level of aggregation of the model used in the preceding chapter and the inherent limitations of static CGE models, the precise size of the numerical estimates of the effects of the tax and CAP policy changes should be taken with a grain of salt. Nevertheless, the results are sufficiently convincing that useful policy implications can be deduced from the analysis in Chapter 4. This is done in the next section. The final section discusses the limitations of this study and suggests extensions of the analysis.

Policy Implications

The results summarized above show that the tax changes proposed by the EC Commission would require Denmark to make quite extensive changes in its tax structure, and indeed in the structure of the economy. This is not surprising in view of the fact that the Commission's proposal is based on an average of the 12 member countries, and, as discussed in Chapter 2, the Danish tax system is quite unique compared to those of the other EC countries in its extensive reliance on indirect and income taxes and the overall high tax burden.

The implementation of indirect tax harmonization must take place in a way which minimizes any damage to the macroeconomic balance. Denmark is already one of the most indebted industrialized countries, and further deterioration of the current account is simply not acceptable to Danish policy-makers. In light of this objective, the results from the savings-driven version of the model are particularly instructive: to reduce indirect taxes while keeping the current account deficit in the 3% of GDP range requires reductions of government transfer payments to households *and* of government consumption in the order of magnitude of 10% to 15%. Having witnessed how difficult it is merely to halt the growth in public spending, on both sides of the Atlantic, it is difficult to imagine how cuts of this magnitude could be made politically acceptable in a country where the welfare state is regarded as the greatest achievement of the 20th century.

In light of the fact that each country still has veto power in the EC in tax matters, one might argue that the EC cannot force Denmark to make tax changes it does want to make. However, as was pointed out in Chapter 1, if border checkpoints are abolished in 1993, market pressures may well force the Danes to adapt their tax system to the rest of Europe, and questions of veto power in the EC Council of Ministers may become irrelevant. Some Danish politicians have in the past expressed hopes that the Community would allow

Denmark to retain some of its exceptions to the free movement of goods, such as the "two-day rule" which requires an overnight stay in another country before duty free importation of substantial amounts of alcohol, tobacco and other highly taxed goods is allowed. However, recent pronouncements from Brussels have made it clear that no special rules for Denmark (or the Irish Republic, which also has high excise taxes and faces cross-border shopping problems *vis a vis* Britain in Northern Ireland) will be permitted after 1992.

It is worth noting that even if the estimates of the macroeconomic impact of the indirect tax reductions are off by, say, 50%, Denmark still faces very difficult political choices as a consequence of tax harmonization, especially if direct taxes are to be lowered as well.

The most likely response will be a mix of the strategies outlined in Chapter 2: some increase in payroll taxes, some reductions in government spending (or at least a slowing of its growth), some indirect tax cuts (but not to the full extent proposed by the EC Commission), and in the end, acceptance of a certain amount of cross-border shopping. After all, Denmark already enjoys a certain amount of cross-border shopping by Norwegians and Swedes, whose governments tax certain goods, especially alcoholic beverages, at much higher rates. So an equilibrium could develop, where Danes living in the southern part of the country make shopping trips to Germany, while the northern and eastern parts of Denmark benefit from increased patronage of their Scandinavian neighbors[1], for whom Denmark will be a low-tax shopper's paradise.

Harmonization of indirect taxes is a virtual certainty, and harmonization of other taxes probable, at least in the long run. In contrast, outright abolition of the CAP must be said to be in the realm of speculation at this time. Nevertheless, some form of CAP reform will probably occur due to the internal and external pressure on the EC. Indeed, during the second half of the 1980s, tentative steps toward reform have already been taken. Whether reform takes the form of increased quantity management of agricultural output (as in the dairy sector), through lower guaranteed prices, or through some other scheme such as direct payments to farmers, there is no doubt that the changes made will not be favorable to Denmark[2]. The results from the savings-driven model with a fixed exchange rate, summarized in the first section of this chapter, confirm the results of the studies cited in Chapter

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[1] An analogous situation exists among some American states. For example, inhabitants of western New Jersey can save up to $5 on a carton of cigarettes by driving a few miles to Pennsylvania, while retailers in eastern New Jersey enjoy considerable business from New Yorkers who drive to the Garden State to buy clothes, which are not subject to the sales tax there.

[2] One concrete and very recent example is the proposal by the EC Agriculture Commissioner, Ray MacSharry (see "Europe's Latest Farming Muddle", *The Economist*, 23 February 1991), to move away from price support toward direct income supplements for small farmers. Since Danish farms tend to be large compared to the EC average, this change would undoubtedly hurt Danish agriculture.

3, which point to Denmark (along with Holland and Ireland) as one of the big beneficiaries of the CAP in its current form. Since this is also the widespread perception within the EC, and given the country's high GDP per capita, Denmark is unlikely to encounter much sympathy from its EC partners in future negotiations over CAP reform.

How Denmark would deal with radical CAP reform is uncertain. One course of action might be to follow the route of New Zealand. In 1984, that country abolished all its agricultural price supports, which until then had been among the highest in the world. Although the initial effects on the economy were not unlike those estimated for Denmark in this study, over time New Zealand agriculture has adapted and become so efficient that farms are profitable, even at extremely low world price levels[3]. In the process, the number of farms was sharply reduced while the average farm size increased. A similar development has already been occurring in Denmark over the last few decades. For example, between 1970 and 1985, the average farm size in Denmark increased by more than 40%[4]. Many Danes bemoan the loss of the rural way of life this represents, but any liberalization of the CAP would further accelerate this trend. Danish agriculture is regarded as comparatively efficient, and might very well perform quite satisfactorily on an open world market.

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[3] For a brief description of New Zealand's agriculture liberalization, see "Sell Them Sunny Meadows", *The Economist*, 23 February 1991.

[4] See Sørensen (1987, p. 135).

Limitations of the Study

The discussion of possible adjustments to CAP reform in the preceding section points to one obvious limitation of static CGE analysis, namely that it is indeed static and does not take dynamic effects such as endogenous technological progress into account. In connection with discussions of gains to the EC as a whole from removal of internal trade barriers, several authors, such as Jacquemin (1989) and Baldwin (1989), have pointed out that many of the most significant effects of trade liberalization are dynamic in nature and cannot be properly analyzed with a static model[5]. The static nature of the model also leads to a classification of investment as simply another demand category, ignoring its effects on capital accumulation and hence future output.

Another omission in a model such as the one used here is the effect of imperfect competition, product differentiation, and increasing returns to scale. And yet, as Jacquemin (1989) points out, many if not most of the beneficial effects of the internal market relate to precisely those features of Europe's economy. Harris (1983), in a CGE model of Canada, demonstrated that gains from trade liberalization are significantly understated if market imperfections are ignored. On balance, however, it is not clear whether assuming perfect competition is a serious error when analyzing agricultural policy, since the market for farm products is the standard example given by economists when asked for an example of a competitive market.

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[5] Baldwin (1989) estimates that the overall *1992* program will raise the permanent GDP growth rate in the EC by between 0.3 and 1.0 percentage points. The effects of such an increase would within a few years dwarf the static gains of 4.5-6% estimated by the EC Commission in the Cecchini report (cited in *European Economy*, no. 35).

Finally, the labor market specifications used in the simulations in Chapter 4 are not entirely satisfactory. There, the labor supply function is either horizontal (the Keynesian closure) or vertical (the neoclassical closure). A more realistic labor market specification would include an upward sloping labor supply curve, at least up to the full employment level.

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APPENDIX A
SOCIAL ACCOUNTING MATRIX

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Labor														
2	Capital														
3	Households–income	306096	101109			114172									
4	Households–consumption			308103											
5	Government–income							164698	7481		28051				
6	Government–consumption					146176									
7	Direct tax			150474					14224						
8	Companies		48116												
9	Savings–investment			76974		−17941			26411						
10	Indirect tax											434	10704	0	2040
11	FOOD incl. indirect tax														
12	BT incl. indirect tax														
13	CL incl. indirect tax														
14	RFP incl. indirect tax														
15	FURN incl. indirect tax														
16	MED incl. indirect tax														
17	TRANS incl. indirect tax														
18	LEIS incl. indirect tax														
19	MISC incl. indirect tax														
20	VAT														
21	VA–agriculture														
22	VA–industry														
23	VA–services														
24	Production–agriculture														
25	Production–industry														
26	Production–services														
27	Domestic goods–agriculture														
28	Domestic goods–industry														
29	Domestic services														
30	Imported goods–agriculture														
31	Imported goods–industry														
32	Imported services														
33	Composite goods–agriculture											30729	5358	45	275
34	Composite goods–industry											39	33	9358	5225
35	Composite services						146176					11994	3462	5396	67793
36	CONS–FOOD				52049										
37	CONS–BT				23379										
38	CONS–CL				17832										
39	CONS–RFP				78716										
40	CONS–FURN				20808										
41	CONS–MED				5572										
42	CONS–TC				51869										
43	CONS–LEIS				29608										
44	CONS–MISC				28270										
45	INV–MACH									35276					
46	INV–TRANS									8586					
47	INV–CONST									53685					
48	INV–OTHER									6390					
49	Exports–agriculture														
50	Exports–industry														
51	Exports–services														
52	Factors–abroad														
53	Rest–of–world		26357			13383									
54	Statistical discrepancy														
	COLUMN TOTAL	306096	175582	535551	308103	255790	146176	164698	48116	103937	28051	43196	19557	14799	75333

		15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	Labor							17750	54337	234009					
2	Capital							34695	25879	115008					
3	Households-income														
4	Households-consumption														
5	Government-income						55560								
6	Government-consumption														
7	Direct tax														
8	Companies														
9	Savings-investment														
10	Indirect tax	302	22	12106	446	793					-1768	364	3846		
11	FOOD incl. indirect tax														
12	BT incl. indirect tax														
13	CL incl. indirect tax														
14	RFP incl. indirect tax														
15	FURN incl. indirect tax														
16	MED incl. indirect tax														
17	TRANS incl. indirect tax														
18	LEIS incl. indirect tax														
19	MISC incl. indirect tax														
20	VAT										47	127	11540		
21	VA-agriculture										52445				
22	VA-industry											80216			
23	VA-services												349017		
24	Production-agriculture													93673	
25	Production-industry														102150
26	Production-services														
27	Domestic goods-agriculture														
28	Domestic goods-industry														
29	Domestic services														
30	Imported goods-agriculture														
31	Imported goods-industry														
32	Imported services														
33	Composite goods-agriculture	50	16	5	1498	48					72299	3559	7286		
34	Composite goods-industry	9013	1130	8538	7324	1908					16971	95675	68825		
35	Composite services	8152	3904	25314	16675	21289					15835	27740	142924		
36	CONS-FOOD														
37	CONS-BT														
38	CONS-CL														
39	CONS-RFP														
40	CONS-FURN														
41	CONS-MED														
42	CONS-TC														
43	CONS-LEIS														
44	CONS-MISC														
45	INV-MACH														
46	INV-TRANS														
47	INV-CONST														
48	INV-OTHER														
49	Exports-agriculture														
50	Exports-industry														
51	Exports-services														
52	Factors-abroad														
53	Rest-of-world														
54	Statistical discrepancy														
	COLUMN TOTAL	17517	5072	45963	25943	24038	55560	52445	80216	349017	155829	207681	583438	93673	102150

		29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	Labor														
2	Capital														
3	Households-income														
4	Households-consumption														
5	Government-income														
6	Government-consumption														
7	Direct tax														
8	Companies														
9	Savings-investment														
10	Indirect tax			1694											
11	FOOD incl. indirect tax								43196						
12	BT incl. indirect tax									19557					
13	CL incl. indirect tax										14799				
14	RFP incl. indirect tax											75333			
15	FURN incl. indirect tax												17517		
16	MED incl. indirect tax													5072	
17	TRANS incl. indirect tax														45963
18	LEIS incl. indirect tax														
19	MISC incl. indirect tax														
20	VAT								8853	3822	3033	3383	3291	500	5906
21	VA-agriculture														
22	VA-industry														
23	VA-services														
24	Production-agriculture														
25	Production-industry														
26	Production-services	538607													
27	Domestic goods-agriculture					93673									
28	Domestic goods-industry						102150								
29	Domestic services							538607							
30	Imported goods-agriculture					27206									
31	Imported goods-industry						154972								
32	Imported services							19927							
33	Composite goods-agriculture														
34	Composite goods-industry														
35	Composite services														
36	CONS-FOOD														
37	CONS-BT														
38	CONS-CL														
39	CONS-RFP														
40	CONS-FURN														
41	CONS-MED														
42	CONS-TC														
43	CONS-LEIS														
44	CONS-MISC														
45	INV-MACH														
46	INV-TRANS														
47	INV-CONST														
48	INV-OTHER														
49	Exports-agriculture														
50	Exports-industry														
51	Exports-services														
52	Factors-abroad														
53	Rest-of-world		27206	153278	19927										
54	Statistical discrepancy					2690	5641	-8331							
	COLUMN TOTAL	538607	27206	154972	19927	123569	262763	550203	52049	23379	17832	78716	20808	5572	51869

		43	44	45	46	47	48	49	50	51	52	53	54	ROW TOTAL
1	Labor													306096
2	Capital													175582
3	Households–income										14174			535551
4	Households–consumption													308103
5	Government–income													255790
6	Government–consumption													146176
7	Direct tax													164696
8	Companies													48116
9	Savings–investment											18493		103937
10	Indirect tax			144	831	1127		–5034						28051
11	FOOD incl. indirect tax													43196
12	BT incl. indirect tax													19557
13	CL incl. indirect tax													14799
14	RFP incl. indirect tax													75333
15	FURN incl. indirect tax													17517
16	MED incl. indirect tax													5072
17	TRANS incl. indirect tax													45963
18	LEIS incl. indirect tax	25943												25943
19	MISC incl. indirect tax		24038											24038
20	VAT	3665	4232	885	244	6032								55560
21	VA–agriculture													52445
22	VA–industry													80216
23	VA–services													349017
24	Production–agriculture							62156						155829
25	Production–industry								105531					207681
26	Production–services									44831				583438
27	Domestic goods–agriculture													93673
28	Domestic goods–industry													102150
29	Domestic services													538607
30	Imported goods–agriculture													27206
31	Imported goods–industry													154972
32	Imported services													19927
33	Composite goods–agriculture			59	0	0	2342							123569
34	Composite goods–industry			28148	6644	0	3932							262763
35	Composite services			6040	867	46526	116							550203
36	CONS–FOOD													52049
37	CONS–BT													23379
38	CONS–CL													17832
39	CONS–RFP													78716
40	CONS–FURN													20806
41	CONS–MED													5572
42	CONS–TC													51869
43	CONS–LEIS													29606
44	CONS–MISC													28270
45	INV–MACH													35276
46	INV–TRANS													8586
47	INV–CONST													53685
48	INV–OTHER													6390
49	Exports–agriculture											57122		57122
50	Exports–industry											105531		105531
51	Exports–services											44831		44831
52	Factors–abroad											14174		14174
53	Rest–of–world													240151
54	Statistical discrepancy													0
	COLUMN TOTAL	29606	28270	35276	8586	53685	6390	57122	105531	44831	14174	240151	0	

APPENDIX B
HERCULES REPRESENTATION OF THE MODEL

Below is shown the GAMS/HERCULES program for the investment-driven model with neoclassical labor market. The first part of the program defines the various sets and acronyms. Then the Social Accounting Matrix is defined, and the functional forms for the payments in the SAM are specified. The final section contains the tax experiment definitions and report commands.

```
$TITLE MODTAX: 3-SECTOR MODEL FOR TAX HARMONIZATION ANALYSIS
$STITLE DEFINITION OF ACCOUNT SET AND ACRONYMS
*  This model has 3 sectors: Agriculture, Industry, and Services.
*  There are 9 consumption goods and 4 investment goods.
*  It is based on a SAM for 1984 constructed from national accounts
*  and input-output tables. There is a distinction between VAT and
*  other indirect taxes. Capital is fixed in each sector.
*  The wage rate is flexible, and aggregate employment is fixed.
*  Elasticity values: (1) Export demand - AG 5, IN 2.5, SE 1.
*                     (2) Substitution between imported and domestic
*                         goods - AG 3.0, IN 1.0, SE 0.5.
*  THIS IS THE INVESTMENT-DRIVEN VERSION OF THE MODEL
*
 SET  ACC  ACCOUNTS /
         LABOR         LABOR
         CAPITAL       TOTAL CAPITAL
         K-AG          CAPITAL IN AGRICULTURE
         K-IN          CAPITAL IN INDUSTRY
         K-SE          CAPITAL IN SERVICES
         FAC-ABR       FACTORS EMPLOYED ABROAD
         HH-INCM       HOUSEHOLD INCOME
         HH-CONS       HOUSEHOLD CONSUMPTION
         COMPANIES     COMPANIES
         G-INCM        GOVERNMENT INCOME
         G-CONS        GOVERNMENT CONSUMPTION
         INDR-TAX      INDIRECT TAX
         VAT           VALUE ADDED TAX
         IFOOD         FOOD INCLUDING INDIRECT TAX
         IBT           BT INCLUDING INDIRECT TAX
         ICLOTH        CLOTH INCLUDING INDIRECT TAX
         IRFP          RFP INCLUDING INDIRECT TAX
         IFURN         FURN INCLUDING INDIRECT TAX
```

```
        IMED        MED INCLUDING INDIRECT TAX
        ITRANS      TRANS INCLUDING INDIRECT TAX
        ILEIS       LEIS INCLUDING INDIRECT TAX
        IOTH        OTH INCLUDING INDIRECT TAX
        DIR-TAX     DIRECT TAX
        SAV-INV     SAVINGS AND INVESTMENT
        VAL-ADD-AG  VALUE-ADDED IN AGRICULTURE
        VAL-ADD-IN  VALUE-ADDED IN INDUSTRY
        VAL-ADD-SE  VALUE-ADDED IN SERVICES
        PROD-AG     PRODUCTION ACTIVITY FOR AGRICULTURE
        PROD-IN     PRODUCTION ACTIVITY FOR INDUSTRY
        PROD-SE     PRODUCTION ACTIVITY FOR SERVICES
        COM-DOM-AG  DOMESTIC AGRICULTURAL COMMODITIES
        COM-DOM-IN  DOMESTIC INDUSTRIAL COMMODITIES
        COM-DOM-SE  DOMESTIC SERVICE COMMODITIES
        COM-IMP-AG  IMPORTED AGRICULTURAL COMMODITIES
        COM-IMP-IN  IMPORTED INDUSTRIAL COMMODITIES
        COM-IMP-SE  IMPORTED SERVICE COMMODITIES
        COM-CMP-AG  COMPOSITE AGRICULTURAL COMMODITIES
        COM-CMP-IN  COMPOSITE INDUSTRIAL COMMODITIES
        COM-CMP-SE  COMPOSITE SERVICE COMMODITIES
        COM-EXP-AG  AGRICULTURAL EXPORT COMMODITIES
        COM-EXP-IN  INDUSTRIAL EXPORT COMMODITIES
        COM-EXP-SE  SERVICE EXPORT COMMODITIES
        CONS-FOOD   CONSUMPTION-FOOD
        CONS-BT     CONSUMPTION-BEVERAGES AND TOBACCO
        CONS-CLOTH  CONSUMPTION-CLOTHING AND FOOTWEAR
        CONS-RFP    CONSUMPTION-GROSS RENT FUEL POWER
        CONS-FURN   CONSUMPTION-FURNITURE HOUSEHOLD OP
        CONS-MED    CONSUMPTION-MEDICAL
        CONS-TRANS  CONSUMPTION-TRANSPORT COMMUNICATION
        CONS-LEIS   CONSUMPTION-LEISURE ENTERTAINMENT
        CONS-OTH    CONSUMPTION-OTHER
        INV-MACH    INVESTMENT-MACHINERY
        INV-TRANS   INVESTMENT-TRANSPORT EQUIPMENT
        INV-BUILD   INVESTMENT-BUILDINGS
        INV-OTH     INVESTMENT-OTHER
        REST-WORLD  REST OF THE WORLD ACCOUNT
        STAT-DISCR  STATISTICAL DISCREPANCY  /

ALIAS (ACC,ACCP);

ACRONYMS AC       ACTIVITY OR COMMODITY ACCOUNT
         INST     INSTITUTIONS ACCOUNT
         INSTC    INSTITUTIONS CONSUMPTION ACCOUNT
         MF       MARKET FACTOR ACCOUNT
         NMF      NON-MARKET FACTOR ACCOUNT
         ROW      REST OF THE WORLD ACCOUNT
         TAX      INDIRECT TAX ACCOUNT
         NP       PRICE FIXED - NUMERAIRE
         Q        QUANTITY FIXED
         CD       COBB-DOUGLAS PRODUCTION FUNCTION
         CES      CES PRODUCTION FUNCTION
         EXPORT   DEMAND FROM REST OF THE WORLD FOR EXPORTS
         FEXO     EXOGENOUS VALUE (IN FOREIGN CURRENCY)
         IDIST    INCOME DISTRIBUTION SPECIFICATION
         IMPORT   PAYMENT TO THE REST OF THE WORLD FOR IMPORTED GOODS
         IO       INPUT-OUTPUT SPECIFICATION
         ITAX     INDIRECT TAX SPECIFICATION
         DTAX     DIRECT TAX SPECIFICATION
         QEXO     FIXED QUANTITY SPECIFICATION
         QSHR     QUANTITY SHARE SPECIFICATION
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```
          TEXO    EXOGENOUS VALUE (IN DOMESTIC CURRENCY)
          UNSPEC  UNSPECIFIED OR RESIDUAL
          LES     LINEAR EXPENDITURE SYSTEM
          VSHR    VALUE SHARE SPECIFICATION
$STITLE  DEFINITION OF SOCIAL ACCOUNTING MATRIX
 TABLE  SAM(ACC,ACC)  SOCIAL ACCOUNTING MATRIX

             LABOR  CAPITAL HH-INCM  HH-CONS  G-INCM  G-CONS  DIR-TAX
 HH-INCM     306096  101109                   114172
 HH-CONS                     308103
 G-INCM                                                        164698
 G-CONS                                       146176
 DIR-TAX                     150474
 COMPANIES            48116
 SAV-INV                      76974           -17941
 COM-CMP-SE                                           146176
 CONS-FOOD                             52049
 CONS-BT                               23379
 CONS-CLOTH                            17832
 CONS-RFP                              78716
 CONS-FURN                             20808
 CONS-MED                               5572
 CONS-TRANS                            51869
 CONS-LEIS                             29608
 CONS-OTH                              28270
 REST-WORLD           26357                    13383

        +   COMPANIES  SAV-INV   INDR-TAX  VAT   VAL-ADD-AG  VAL-ADD-IN
 LABOR                                            17750        54337
 K-AG                                             34695
 K-IN                                                          25879
 G-INCM         7481               28051   55560
 DIR-TAX       14224
 SAV-INV       26411
 INV-MACH                35276
 INV-TRANS                8586
 INV-BUILD               53685
 INV-OTH                  6390

         +  IFOOD    IBT ICLOTH  IRFP  IFURN  IMED ITRANS   ILEIS  IOTH
 INDR-TAX     434   10704    0   2040    302    22  12106     446   793
 COM-CMP-AG 30729    5358   45    275     50    16      5    1498    48
 COM-CMP-IN    39      33 9358   5225   9013  1130   8538    7324  1908
 COM-CMP-SE 11994    3462 5396  67793   8152  3904  25314   16675 21289

         +    VAL-ADD-SE   PROD-AG   PROD-IN   PROD-SE   COM-DOM-AG
 LABOR           234009
 K-SE            115008
 INDR-TAX                   -1768        364      3846
 VAT                           47        127     11540
 VAL-ADD-AG                 52445
 VAL-ADD-IN                            80216
 VAL-ADD-SE                                     349017
 PROD-AG                                                     93673
 COM-CMP-AG                 72299       3559      7286
 COM-CMP-IN                 16971      95675     68825
 COM-CMP-SE                 15835      27740    142924

         +    COM-DOM-IN  COM-DOM-SE  COM-IMP-AG  COM-IMP-IN  COM-IMP-SE
 INDR-TAX                                             1694
 PROD-IN         102150
 PROD-SE                     538607
```

```
REST-WORLD                             27206       153278       19927

       +     COM-CMP-AG  COM-CMP-IN  COM-CMP-SE  CONS-FOOD  CONS-BT
VAT                                                 8853      3822
COM-DOM-AG      93673
COM-DOM-IN                 102150
COM-DOM-SE                             538607
COM-IMP-AG      27206
COM-IMP-IN                 154972
COM-IMP-SE                              19927
IFOOD                                              43196
IBT                                                          19557
STAT-DISCR       2690        5641       -8331

       +     CONS-CLOTH  CONS-RFP  CONS-FURN  CONS-MED  CONS-TRANS
VAT             3033        3383       3291       500      5906
ICLOTH         14799
IRFP                       75333
IFURN                                 17517
IMED                                             5072
ITRANS                                                    45963

       +     CONS-LEIS  CONS-OTH  INV-MACH  INV-TRANS  INV-BUILD
INDR-TAX                              144       831       1127
VAT             3665        4232      885       244       6032
ILEIS          25943
IOTH                       24038
COM-CMP-AG                             59
COM-CMP-IN                          28148      6644
COM-CMP-SE                           6040       867      46526

       +     INV-OTH   COM-EXP-AG   COM-EXP-IN
INDR-TAX                   -5034
PROD-AG                    62156
PROD-IN                                105531
COM-CMP-AG      2342
COM-CMP-IN      3932
COM-CMP-SE       116

       +   COM-EXP-SE  K-AG  K-IN  K-SE  FAC-ABR  REST-WORLD STAT-DISCR
CAPITAL               34695 25879 115008
HH-INCM                                   14174
G-INCM                                                            0
SAV-INV                                              18493
PROD-SE       44831
COM-EXP-AG                                           57122
COM-EXP-IN                                          105531
COM-EXP-SE                                           44831
FAC-ABR                                              14174

$STITLE  DEFINITION OF SPECIFICATIONS AND CELL TABLE
TABLE  SPEC(ACC,ACC)  SPECIFICATIONS TABLE

            LABOR  CAPITAL  HH-INCM  HH-CONS  G-INCM  G-CONS  DIR-TAX
HH-INCM     IDIST   IDIST                      TEXO
HH-CONS                      IDIST
G-INCM                                                         IDIST
G-CONS                                        UNSPEC
DIR-TAX                      DTAX
COMPANIES           IDIST
SAV-INV                      IDIST            UNSPEC
COM-CMP-SE                                             QEXO
```

CONS-FOOD		LES	
CONS-BT		LES	
CONS-CLOTH		LES	
CONS-RFP		LES	
CONS-FURN		LES	
CONS-MED		LES	
CONS-TRANS		LES	
CONS-LEIS		LES	
CONS-OTH		LES	
REST-WORLD	IDIST		TEXO

+	COMPANIES	SAV-INV	INDR-TAX	VAT	VAL-ADD-AG	VAL-ADD-IN
LABOR					CD	CD
K-AG					CD	
K-IN						CD
G-INCM	IDIST		IDIST	IDIST		
DIR-TAX	DTAX					
SAV-INV	IDIST					
INV-MACH		QSHR				
INV-TRANS		QSHR				
INV-BUILD		QSHR				
INV-OTH		QSHR				

+	IFOOD	IBT	ICLOTH	IRFP	IFURN	IMED	ITRANS	ILEIS	IOTH
INDR-TAX	ITAX	ITAX	ITAX	ITAX	ITAX	ITAX	ITAX	ITAX	ITAX
COM-CMP-AG	IO	IO	IO	IO	IO	IO	IO	IO	IO
COM-CMP-IN	IO	IO	IO	IO	IO	IO	IO	IO	IO
COM-CMP-SE	IO	IO	IO	IO	IO	IO	IO	IO	IO

+	VAL-ADD-SE	PROD-AG	PROD-IN	PROD-SE	COM-DOM-AG
LABOR	CD				
K-SE	CD				
INDR-TAX		ITAX	ITAX	ITAX	
VAT		ITAX	ITAX	ITAX	
VAL-ADD-AG		IO			
VAL-ADD-IN			IO		
VAL-ADD-SE				IO	
PROD-AG					IO
COM-CMP-AG		IO	IO	IO	
COM-CMP-IN		IO	IO	IO	
COM-CMP-SE		IO	IO	IO	

+	COM-DOM-IN	COM-DOM-SE	COM-IMP-AG	COM-IMP-IN	COM-IMP-SE
INDR-TAX				ITAX	
PROD-IN	IO				
PROD-SE		IO			
REST-WORLD			IMPORT	IMPORT	IMPORT

+	COM-CMP-AG	COM-CMP-IN	COM-CMP-SE	CONS-FOOD	CONS-BT
VAT				ITAX	ITAX
COM-DOM-AG	CES				
COM-DOM-IN		CES			
COM-DOM-SE			CES		
COM-IMP-AG	CES				
COM-IMP-IN		CES			
COM-IMP-SE			CES		
IFOOD				IO	
IBT					IO
STAT-DISCR	ITAX	ITAX	ITAX		

+	CONS-CLOTH	CONS-RFP	CONS-FURN	CONS-MED	CONS-TRANS
VAT	ITAX	ITAX	ITAX	ITAX	ITAX

```
ICLOTH           IO
IRFP                        IO
IFURN                                  IO
IMED                                             IO
ITRANS                                                      IO

       +     CONS-LEIS  CONS-OTH  INV-MACH  INV-TRANS  INV-BUILD
INDR-TAX                             ITAX      ITAX       ITAX
VAT             ITAX        ITAX     ITAX      ITAX       ITAX
ILEIS            IO
IOTH                        IO
COM-CMP-AG                          IO
COM-CMP-IN                          IO        IO
COM-CMP-SE                          IO        IO         IO

       +     INV-OTH   COM-EXP-AG   COM-EXP-IN
INDR-TAX                   ITAX
PROD-AG                     IO
PROD-IN                                IO
COM-CMP-AG      IO
COM-CMP-IN      IO
COM-CMP-SE      IO

       +   COM-EXP-SE  K-AG  K-IN  K-SE  FAC-ABR  REST-WORLD STAT-DISCR
CAPITAL                IDIST IDIST IDIST
HH-INCM                                   IDIST
G-INCM                                                          IDIST
SAV-INV                                              UNSPEC
PROD-SE          IO
COM-EXP-AG                                           EXPORT
COM-EXP-IN                                           EXPORT
COM-EXP-SE                                           EXPORT
FAC-ABR                                               FEXO

SET  ACCEX(ACC)  EXPORTED COMMODITIES
    /  COM-EXP-AG   , COM-EXP-IN   , COM-EXP-SE /

SET ACCCONS(ACC)  CONSUMER EXPENDITURE
    /  CONS-FOOD , CONS-BT , CONS-CLOTH , CONS-RFP , CONS-FURN
       CONS-MED , CONS-TRANS , CONS-LEIS , CONS-OTH /

PARAMETER  ETAS(ACCEX)  ELASTICITY OF DEMAND FOR EXPORTS  /
         COM-EXP-AG = 5.0 , COM-EXP-IN = 2.5 , COM-EXP-SE = 1.0 /

PARAMETER  ALPHAS(ACCCONS)  COMMITTED QUANTITY IN LES  /
         CONS-FOOD = 43478
         CONS-BT = 10645
         CONS-CLOTH = 3208
         CONS-RFP = 26260
         CONS-FURN = -3081
         CONS-MED = -2037
         CONS-TRANS = -9819
         CONS-LEIS = -349
         CONS-OTH = -1006   /

PARAMETER  CT(ACC,ACC,*)  CELL TABLE;

   CT(ACC,ACCP,"TBASE")          = SAM(ACC,ACCP);
   CT(ACC,ACCP,"SPECS")          = SPEC(ACC,ACCP);
   CT(ACCEX,"REST-WORLD","ETA")  = ETAS(ACCEX);
   CT(ACCCONS,"HH-CONS","ALPHA") = ALPHAS(ACCCONS);
```

```
$STITLE  ACCOUNT TABLE
 TABLE  AT(ACC,*)  ACCOUNT TABLE

                     TYPE   FIX   SIGMA
          LABOR       MF     Q
          CAPITAL     INST
          K-AG        MF     Q
          K-IN        MF     Q
          K-SE        MF     Q
          FAC-ABR     NMF
          HH-INCM     INST
          HH-CONS     INSTC
          COMPANIES   INST
          G-INCM      INST
          G-CONS      INSTC
          INDR-TAX    TAX
          VAT         TAX
          IFOOD       AC
          IBT         AC
          ICLOTH      AC
          IRFP        AC
          IFURN       AC
          IMED        AC
          ITRANS      AC
          ILEIS       AC
          IOTH        AC
          DIR-TAX     TAX
          SAV-INV     INSTC  Q
          VAL-ADD-AG  AC
          VAL-ADD-IN  AC
          VAL-ADD-SE  AC
          PROD-AG     AC
          PROD-IN     AC
          PROD-SE     AC
          COM-DOM-AG  AC
          COM-DOM-IN  AC
          COM-DOM-SE  AC
          COM-IMP-AG  AC
          COM-IMP-IN  AC
          COM-IMP-SE  AC
          COM-CMP-AG  AC             3.0
          COM-CMP-IN  AC             1.0
          COM-CMP-SE  AC             0.5
          CONS-FOOD   AC
          CONS-BT     AC
          CONS-CLOTH  AC
          CONS-RFP    AC
          CONS-FURN   AC
          CONS-MED    AC
          CONS-TRANS  AC
          CONS-LEIS   AC
          CONS-OTH    AC
          INV-MACH    AC
          INV-TRANS   AC
          INV-BUILD   AC
          INV-OTH     AC
          COM-EXP-AG  AC
          COM-EXP-IN  AC
          COM-EXP-SE  AC
          REST-WORLD  ROW    NP
          STAT-DISCR  TAX
```

```
* Computation of account totals and check for imbalances of the SAM
*
 PARAMETER TOTALS(ACC,*)  ACCOUNT TOTALS AND IMBALANCES FOR THE SAM;
 TOTALS(ACC,"ROW-TOTAL") = SUM(ACCP,SAM(ACC,ACCP));
 TOTALS(ACCP,"COL-TOTAL") = SUM(ACC,SAM(ACC,ACCP));
 TOTALS(ACC,"DIFFERENCE") =
 TOTALS(ACC,"ROW-TOTAL")-TOTALS(ACC,"COL-TOTAL");
 DISPLAY "CHECK FOR BALANCE OF BASE SAM:",TOTALS;

$STITLE MODEL AND EXPERIMENT DEFINITION AND SOLUTION REPORT
 MODEL  MODTAX   3-SECTOR MODEL OF DENMARK
                / ACC, AT, CT /;

* Define sets and parameters for report statements
*
 SET CASES  SET OF CASES TO BE MODELED
           / BASE-CASE, "VAT-CUT" , "GOVEXP-10%" /
 SET FINUSE(ACC)  ACCOUNTS FOR FINAL USE
           / HH-CONS, G-CONS, SAV-INV /
 SET GOODS(ACC)  COMMODITIES
          / COM-DOM-AG, COM-DOM-IN, COM-DOM-SE, COM-IMP-AG, COM-IMP-IN,
            COM-IMP-SE, COM-CMP-AG, COM-CMP-IN, COM-CMP-SE, COM-EXP-AG,
            COM-EXP-IN, COM-EXP-SE /
 SET FACTORS(ACC)  FACTORS OF PRODUCTION
           / LABOR, K-AG, K-IN, K-SE /
 SET PQY  SET WITH PRICE QUANTITY AND VALUE
           / PRICE, QUANTITY, VALUE /
 SET BALANCES  TRADE AND GOVERNMENT DEFICITS
           / TRADE, PAYMENTS, GOVERNMENT /
 T(CASES)  COLUMN LABELS FOR REPORTS

 PARAMETER REPORT1(PQY,FINUSE,CASES)  FINAL USES
           REPORT2(PQY,FACTORS,CASES)  FACTOR PRICES
           REPORT3(PQY,GOODS,CASES)  COMMODITY PRICES
           REPORT4(BALANCES,CASES)  TRADE AND GOVERNMENT BALANCES

 SOLVE  MODTAX USING  HERCULES;
 DISPLAY "ACCOUNT AND CELL TABLES AFTER SOLVING BASE MODEL:", AT,CT;

* Report statements for base case
*
 T("BASE-CASE") = YES;
 REPORT1("VALUE",FINUSE,T) = AT(FINUSE,"YSOL");
 REPORT1("QUANTITY",FINUSE,T) = AT(FINUSE,"QSOL");
 REPORT1("PRICE",FINUSE,T) = AT(FINUSE,"PSOL");
 REPORT2("PRICE",FACTORS,T) = AT(FACTORS,"PSOL");
 REPORT3("PRICE",GOODS,T) = AT(GOODS,"PSOL");
 REPORT4("TRADE",T) = AT("COM-EXP-AG","YSOL")+AT("COM-EXP-IN","YSOL")
  +AT("COM-EXP-SE","YSOL")-AT("COM-IMP-AG","YSOL")-AT("COM-IMP-IN","YSOL")
  -AT("COM-IMP-SE","YSOL")+CT("INDR-TAX","COM-IMP-IN","TSOL");
 REPORT4("PAYMENTS",T) = -1*CT("SAV-INV","REST-WORLD","TSOL");
 REPORT4("GOVERNMENT",T) = CT("SAV-INV","G-INCM","TSOL");

* Experiment 1:
* Reduce VAT on FOOD and CLOTHING by 60%, reduce VAT on everything else
* by 10%, reduce indirect taxes on BEVERAGES and TOBACCO by 75% and on
* TRANSPORT by 80%, and all other indirect taxes
* on consumption to 0, without any compensating changes.
*
   CT("VAT","PROD-AG","THETA") =
                    CT("VAT","PROD-AG","THETA-USED")*0.9;
   CT("VAT","PROD-IN","THETA") =
                    CT("VAT","PROD-IN","THETA-USED")*0.9;
 CT("VAT","PROD-SE","THETA") =
                    CT("VAT","PROD-SE","THETA-USED")*0.9;
 CT("VAT","CONS-FOOD","THETA") =
                    CT("VAT","CONS-FOOD","THETA-USED")*0.4;
 CT("VAT","CONS-BT","THETA") =
                    CT("VAT","CONS-BT","THETA-USED")*0.9;
 CT("VAT","CONS-CLOTH","THETA") =
                    CT("VAT","CONS-CLOTH","THETA-USED")*0.4;
 CT("VAT","CONS-RFP","THETA") =
                    CT("VAT","CONS-RFP","THETA-USED")*0.9;
 CT("VAT","CONS-FURN","THETA") =
                    CT("VAT","CONS-FURN","THETA-USED")*0.9;
 CT("VAT","CONS-MED","THETA") =
                    CT("VAT","CONS-MED","THETA-USED")*0.9;
 CT("VAT","CONS-TRANS","THETA") =
                    CT("VAT","CONS-TRANS","THETA-USED")*0.9;
 CT("VAT","CONS-LEIS","THETA") =
                    CT("VAT","CONS-LEIS","THETA-USED")*0.9;
 CT("VAT","CONS-OTH","THETA") =
                    CT("VAT","CONS-OTH","THETA-USED")*0.9;
 CT("VAT","INV-MACH","THETA") =
                    CT("VAT","INV-MACH","THETA-USED")*0.9;
 CT("VAT","INV-TRANS","THETA") =
                    CT("VAT","INV-TRANS","THETA-USED")*0.9;
 CT("VAT","INV-BUILD","THETA") =
                    CT("VAT","INV-BUILD","THETA-USED")*0.9;

 CT("INDR-TAX","IBT","THETA") =
                    CT("INDR-TAX","IBT","THETA-USED")*0.25;
 CT("INDR-TAX","IRFP","THETA") =
                    CT("INDR-TAX","IRFP","THETA-USED")*0;
 CT("INDR-TAX","ITRANS","THETA") =
                    CT("INDR-TAX","ITRANS","THETA-USED")*0.2;
 CT("INDR-TAX","IFOOD","THETA") =
                    CT("INDR-TAX","IFOOD","THETA-USED")*0;
 CT("INDR-TAX","ICLOTH","THETA") =
                    CT("INDR-TAX","ICLOTH","THETA-USED")*0;
 CT("INDR-TAX","IFURN","THETA") =
                    CT("INDR-TAX","IFURN","THETA-USED")*0;
 CT("INDR-TAX","IMED","THETA") =
                    CT("INDR-TAX","IMED","THETA-USED")*0;
 CT("INDR-TAX","ILEIS","THETA") =
                    CT("INDR-TAX","ILEIS","THETA-USED")*0;
 CT("INDR-TAX","IOTH","THETA") =
                    CT("INDR-TAX","IOTH","THETA-USED")*0;

SOLVE  MODTAX USING  HERCULES;
DISPLAY "ACCOUNT AND CELL TABLES AFTER EXPERIMENT 1:", AT,CT;

* Report statements for Experiment 1
*
T(T) = NO; T("VAT-CUT") = YES;
REPORT1("VALUE",FINUSE,T) = AT(FINUSE,"YSOL");
REPORT1("QUANTITY",FINUSE,T) = AT(FINUSE,"QSOL");
REPORT1("PRICE",FINUSE,T) = AT(FINUSE,"PSOL");
REPORT2("PRICE",FACTORS,T) = AT(FACTORS,"PSOL");
REPORT3("PRICE",GOODS,T) = AT(GOODS,"PSOL");
REPORT4("TRADE",T) = AT("COM-EXP-AG","YSOL")+AT("COM-EXP-IN","YSOL")
+AT("COM-EXP-SE","YSOL")-AT("COM-IMP-AG","YSOL")-AT("COM-IMP-IN","YSOL")
 -AT("COM-IMP-SE","YSOL")+CT("INDR-TAX","COM-IMP-IN","TSOL");
REPORT4("PAYMENTS",T) = -1*CT("SAV-INV","REST-WORLD","TSOL");
```

```
REPORT4("GOVERNMENT",T) = CT("SAV-INV","G-INCM","TSOL");

* Experiment 2:
* Compensate for the indirect tax reductions in Experiment 1 by
* cutting government expenditures by 10%
*
   CT("COM-CMP-SE","G-CONS","FQ") =
   CT("COM-CMP-SE","G-CONS","FQ-USED")*0.9;
   CT("HH-INCM","G-INCM","FV") = CT("HH-INCM","G-INCM","FV-USED")*0.9;

 SOLVE  MODTAX USING  HERCULES;
 DISPLAY "ACCOUNT AND CELL TABLES AFTER EXPERIMENT 2:", AT,CT;

* Report statements for Experiment 2
*
 T(T) = NO; T("GOVEXP-10%") = YES;
 REPORT1("VALUE",FINUSE,T) = AT(FINUSE,"YSOL");
 REPORT1("QUANTITY",FINUSE,T) = AT(FINUSE,"QSOL");
 REPORT1("PRICE",FINUSE,T) = AT(FINUSE,"PSOL");
 REPORT2("PRICE",FACTORS,T) = AT(FACTORS,"PSOL");
 REPORT3("PRICE",GOODS,T) = AT(GOODS,"PSOL");
 REPORT4("TRADE",T) = AT("COM-EXP-AG","YSOL")+AT("COM-EXP-IN","YSOL")
  +AT("COM-EXP-SE","YSOL")-AT("COM-IMP-AG","YSOL")-AT("COM-IMP-IN","YSOL")
  -AT("COM-IMP-SE","YSOL")+CT("INDR-TAX","COM-IMP-IN","TSOL");
 REPORT4("PAYMENTS",T) = -1*CT("SAV-INV","REST-WORLD","TSOL");
 REPORT4("GOVERNMENT",T) = CT("SAV-INV","G-INCM","TSOL");

 REPORT4("GOVERNMENT",T) = CT("SAV-INV","G-INCM","TSOL");

 DISPLAY REPORT1, REPORT2, REPORT3, REPORT4;
```

APPENDIX C
CONSUMPTION AND INVESTMENT COMPOSITION MATRICES

Consumption Composition Matrix

	FOOD	BT	CL	RFP	FURN	MED	TC	LEIS	MISC
AG	0.72	0.61	0.00	0.00	0.00	0.00	0.00	0.06	0.00
IN	0.00	0.00	0.63	0.07	0.52	0.22	0.25	0.29	0.08
SE	0.28	0.39	0.36	0.92	0.47	0.77	0.75	0.65	0.92

Investment Composition Matrix

	MACH	TRANS	CONST	OTHER
AG	0.00	0.00	0.00	0.37
IN	0.82	0.88	0.00	0.62
SE	0.18	0.12	1.00	0.02

NOTE: The numbers in a column may not add to 1 due to rounding.

These two matrices show the translation from consumption and investment goods to produced goods. For example, one unit of FOOD consists of 0.72 unit of agricultural commodities and 0.28 unit of services.

BIOGRAPHICAL SKETCH

Nathan Wajsman graduated from the Århus Statsgymnasium high school in Århus, Denmark, in 1979. Following one year of study at the State University of New York at Buffalo, he studied undergraduate economics from 1980 to 1983 at the University of Århus. In 1983, he began graduate study in economics at the State University of New York at Buffalo, transferring to the University of Florida in 1984. He received his master of arts degree there in 1986.

Between 1987 and 1990, Nathan Wajsman was employed as a forecasting analyst at Seminole Electric Cooperative in Tampa, Florida. He also taught economics at Hillsborough Community College in Tampa and Eckerd College in St. Petersburg, Florida. Since 1990, he has held the position of staff supervisor in the Market Analysis & Forecasting department at AT&T in Basking Ridge, New Jersey. He lives with his wife, Aixa, and their son, Moses, in Lawrenceville, New Jersey.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Graduate Research Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Edward Zabel

Edward Zabel
Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Professor of Food and Resource Economics

This dissertation was submitted to the Graduate Faculty of the Department of Economics in the College of Business Administration and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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